WRITTEN STATEMENT OF
THE AMERICAN CIVIL LIBERTIES UNION

For a Hearing on

"The Future of Drones in America: Law Enforcement and Privacy Considerations"

Submitted to the Senate Judiciary Committee

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The American Civil Liberties Union (ACLU) submits this statement to the Senate Judiciary Committee on the occasion of its hearing addressing "The Future of Drones in America: Law Enforcement and Privacy Considerations." This statement describes the privacy and civil liberties implications of the domestic use of unmanned surveillance vehicles, also known as drones, and recommends new protections for use of the technology.

I. Introduction

Unmanned aircraft carrying cameras raise the prospect of a significant new avenue for the surveillance of American life. Many Americans are familiar with these aircraft, commonly called drones, because of their use overseas in places like Afghanistan and Yemen. But drones are coming to America. Recently passed legislation requires the Federal Aviation Administration to "develop a comprehensive plan to safely accelerate the integration of civil unmanned aircraft systems into the national airspace system."[1] This new legislation has dramatically accelerated the deployment of drones and pushed this issue to the forefront. Meanwhile, the technology is quickly becoming cheaper and more powerful, interest in deploying drones among police departments is increasing, and our privacy laws are not strong enough to ensure that the new technology will be used responsibly and consistently with constitutional values. In short, the specter of routine aerial surveillance in American life is on the near horizon — a development that would profoundly change the character of public life in the United States.

We need a system of rules to ensure that Americans can enjoy the benefits of this technology without bringing our country a large step closer to a "surveillance society" in which every move is monitored, tracked, recorded, and scrutinized by the authorities. This statement outlines a set of protections that would protect Americans' privacy in the coming world of drones.

Aerial surveillance from manned aircraft has been with us for decades. One of the first aircraft the Wright brothers built was a surveillance aircraft, and it was sold to the U.S. Army. Many common uses of drone aircraft—search and rescue, fighting wildfires, dangerous tactical police operations—are beneficial. In the 1980s the Supreme Court ruled that the Fourth Amendment does not categorically prohibit the government from carrying out warrantless aerial surveillance of private property.

But manned aircraft are expensive to purchase, operate and maintain, and this expense has always imposed a natural limit on the government's aerial surveillance capability. Now that surveillance can be carried out by unmanned aircraft, this natural limit is eroding. The prospect of cheap, small, portable flying video surveillance machines threatens to eradicate existing practical limits on aerial monitoring and allow for pervasive surveillance, police fishing expeditions, and abusive use of these tools in a way that could eventually eliminate the privacy Americans have traditionally enjoyed in their movements and activities. In order to prevent this harmful and invasive outcome, Congress must act.

II. The Technology

[1] FAA Modernization and Reform Act of 2012, P.L. 112-95, §332, 126 Stat.11, 73.

There are hundreds of different types of Unmanned Aerial Vehicles (UAVs), as drones are formally known.[2] They can be as large as commercial aircraft or as small as hummingbirds, and include human remotely guided aircraft as well as autonomous, self-guided vehicles. They include:

- **Large fixed-wing aircraft.** The largest UAVs currently in use, such as the Israeli-made Eitan, are about the size of a Boeing 737 jetliner. The Eitan's wingspan is 86 feet, and it can stay aloft for 20 hours and reach an altitude of 40,000 feet.[3] The Predator B drone, which has been used extensively on overseas battlefields as well as on the U.S.-Mexico border, has a wingspan of 66 feet, and it can stay aloft for over 30 hours and reach an altitude of 50,000 feet.[4] In Pakistan and Afghanistan, the U.S. military and CIA deploy Predators and Reapers armed with surveillance capability as well as missiles capable of destroying a moving vehicle from thousands of feet in the air.[5]

- **Small fixed-wing aircraft.** Smaller fixed-wing aircraft are the current favorite for domestic deployment. The Houston police department, for example, recently tested the ScanEagle, made by Boeing subsidiary Insitu.[6] The ScanEagle is 4 ½ feet long with a wingspan of 10 feet, and it can climb to 19,500 feet and stay aloft for more than 24 hours.[7]

- **Backpack craft.** Another class of craft is designed to be carried and operated by a single person. The hand-launched AeroVironment Raven, for example, weighs 4 pounds, has a wingspan of 4.5 feet and a length of 3 feet, can fly up to 14,000 feet and stay aloft for up to 110 minutes. Similar-sized products include a three-foot helicopter called the Draganflyer X6, a one-foot-long, one-pound fixed-wing craft called the AeroVironment Wasp, and a fan-propelled craft called the Honeywell T-Hawk that can "hover and stare." Individual hobbyists have also built a number of drones in this size range.[8]

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[2] See Wikipedia, "List of unmanned aerial vehicles," at http://en.wikipedia.org/wiki/List_of_unmanned_aerial_vehicles.

[3] "Israel unveils world's largest UAV," Homeland Security Newswire, Feb. 23, 2010, online at http://homelandsecuritynewswire.com/israel-unveils-worlds-largest-uav.

[4] See General Atomics web page on Predator B at http://www.ga-asi.com/products/aircraft/predator_b.php; R.P.G. Collinson, Introduction to Avionic Systems (2011), p. 495

[5] Yochi J. Dreazen, "From Pakistan, With Love: The technology used to monitor the skies over Waziristan is coming to your hometown," National Journal, March 13, 2011, online at http://www.nationaljournal.com/magazine/drones-may-be-coming-to-your-hometown-20110313.

[6] Stephen Dean, "Police line up to use drones on patrol after Houston secret test," Houston Examiner, Jan. 11, 2010, online at http://www.examiner.com/page-one-in-houston/police-line-up-to-use-drones-on-patrol-after-houston-secret-test.

[7] Insitu, ScanEagle brochure, online at http://www.insitu.com/documents/Insitu%20Website/Marketing%20Collateral/ScanEagle%20Folder%20Insert.pdf

[8] AeroVironment brochure, online at http://www.avinc.com/downloads/Raven_Domestic_1210.pdf; AeroVironment web page on the Wasp at http://www.avinc.com/uas/small_uas/wasp/; Carrie Kahn, "It's A Bird! It's A Plane! It's A Drone!" National Public Radio, March 14, 2011, online at http://www.npr.org/2011/03/14/134533552/its-a-bird-its-a-plane-its-a-drone; "Drones on the home front," Washington Post, Jan. 23, 2011, online at http://www.washingtonpost.com/wp-srv/special/nation/drone-gallery/

- **Hummingbirds.** A tiny drone called the Nano Hummingbird was developed for the Pentagon's Defense Advanced Research Projects Agency (DARPA) by AeroVironment. Intended for stealth surveillance, it can fly up to 11 miles per hour and can hover, fly sideways, backwards and forwards, for about 8 minutes. It has a wingspan of 6.5 inches and weighs only 19 grams—less than a single AA battery.[9]

- **Blimps.** Some blimps are envisioned as high-altitude craft, up to 300 feet in diameter, that would compete with satellites, while others would be low-altitude craft that would allow the police to monitor the streets. Supporters say they are more cost-effective than other craft due to their ability to stay aloft for extended periods.[10]

III. Drone Capabilities—Today and in the Future

The aircraft themselves are steadily improving and, as with so many technologies, that is likely to continue. They are becoming smaller. The military and law enforcement are keenly interested in developing small drones, which have the advantages of being versatile, cheap to buy and maintain, and in some cases so small and quiet that they will escape notice.[11] They are also becoming cheaper. The amazing continual decreases in the prices of electronics that have become normal in our time all but guarantee that the surveillance technologies attached to UAVs will become less expensive and yet more powerful—and with mass production, the aircraft that carry those electronics will become inexpensive enough for a police department to fill the skies over a town with them.

Drones are also becoming smarter. Artificial intelligence advances will likely help drones carry out spying missions. Korean researchers, for example, are working to teach robots how to hide from and sneak up upon a subject.[12] They also will have better staying power, with a greater ability to stay aloft for longer periods of time. Mechanisms for increasing time aloft could include solar power, or the use of blimps or gliders.[13]

Although the primary uses of drones so far have been military, even on overseas battlefields their main use is surveillance. The larger drones can be fitted with weapons or other

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[9] W.J. Hennigan, "It's a bird! It's a spy! It's both," Los Angeles Times, Feb. 17, 2011, online at http://articles.latimes.com/2011/feb/17/business/la-fi-hummingbird-drone-20110217.

[10] On high-altitude blimps see Elliott Minor, "Interest Growing in 'Security' Blimps," Associated Press, April 27, 2004, available online at http://www.rustysforum.com/cgi-bin/domains/com/rustysforum/frc_bb/ultimatebb.cgi?ubb=next_topic&f=1&t=000807&go=older; on low-altitude blimps see e.g. James Nelson, "Utah city may use blimp as anti-crime spy in the sky," Reuters, Jan. 16, 2011, online at http://www.reuters.com/article/2011/01/16/us-crime-blimp-utah-idUSTRE70F1DJ20110116.

[11] W.J. Hennigan, "It's a bird! It's a spy! It's both," Los Angeles Times, Feb. 17, 2011, online at http://articles.latimes.com/2011/feb/17/business/la-fi-hummingbird-drone-20110217.

[12] M. Ryan Calo, "Robots and Privacy," April 2010, online at http://ssrn.com/abstract=1599189.

[13] "Gliders Emerge As Surveillance UAVs," Aviation Week, June 8, 2010, online at http://www.aviationweek.com/aw/generic/story_generic.jsp?topicName=ila_2010&id=news/awx/2010/06/08/awx_06_08_2010_p0-232627.xml; James Nelson, "Utah city may use blimp as anti-crime spy in the sky," Reuters, Jan. 16, 2011, online at http://www.reuters.com/article/2011/01/16/us-crime-blimp-utah-idUSTRE70F1DJ20110116; Ned Smith, "Solar-powered UAV can stay aloft 5 years," TechNewsDaily, Sept. 22, 2010, online at http://www.msnbc.msn.com/id/39313306/ns/technology_and_science-tech_and_gadgets/t/solar-powered-uav-can-stay-aloft-years.

heavy payloads, but all of them can carry cameras and other imaging technologies that have developed amazing capabilities in recent years and are likely to become even more capable in the near future.

Except for possibly the very lightest craft, drones can carry the full range of advanced surveillance technologies that have been developed—and are likely to be developed—including:

- **High-power zoom lenses.** UAVs can carry increasingly powerful lenses that allow significant zooming, increasing the chance that individuals will come under scrutiny from faraway aircraft without knowing it. And the density of photo sensors is growing at an exponential pace (in line with Moore's law), allowing for higher and higher resolution photos to be taken for the same price camera.[14]

- **Night vision.** Infrared and ultraviolet imaging enable night vision by capturing light outside the spectrum visible to the human eye. Infrared imaging (also known as thermal imaging) shows heat emitted by an object, and so is especially suited for identifying humans and animals in the dark.[15] Ultraviolet (UV) imaging can detect some materials not visible in natural or infrared light, and can also be used to enhance detail; for instance, it can be used to image surface textures not apparent in visible light.[16] Moving forward, thermal imaging is likely to improve—for example becoming more sensitive and available at higher resolutions.

- **See-through imaging.** The military is developing radar technologies that can see through ceilings and walls and allow the tracking of human targets even when they are inside buildings.[17] A technology called Synthetic Aperture Radar, for example, can see through cloudy and dusty conditions and through foliage, and has the potential to penetrate the earth and walls.[18]

- **Video analytics.** This field seeks to apply artificial intelligence techniques not just to collect but also to "watch" video. The technology has been improving rapidly, and can

[14] Nathan Myhrvold, "Moore's Law Corollary: Pixel Power," New York Times, June 7, 2006, online at http://www.nytimes.com/2006/06/07/technology/circuits/07essay.html. Moore's law is the observation that the number of transistors that can be placed on an integrated circuit—and therefore broadly speaking the power of computers—doubles approximately every two years. It has held true for over 50 years.
[15] NASA Science Mission Directorate, "Infrared Energy," Mission: Science, 2010, online at http://missionscience.nasa.gov/ems/07_infraredwaves.html.
[16] Austin Richards, "Digital Reflected-Ultraviolet Imaging," Advanced Imaging, Apr. 2006, online at http://www.uvcorder.com/pdf/ADI0406%20Component%2018-20.pdf.
[17] See e.g., William Saletan, "Nowhere To Hide," Slate.com, Sept. 17, 2008, online at http://www.slate.com/articles/health_and_science/human_nature/2008/09/nowhere_to_hide.html Greg Miller and Julian E. Barnes, "Special drones pursue militias," Los Angeles Times, Sept. 12, 2008, online at http://articles.latimes.com/2008/sep/12/world/fg-pakistan12.
[18] "Ground Moving Target Indicator (GMTI) Radar Discrimination of Combatants versus Animals in Severe Clutter," DARPA, undated document (topic number SB082-019), online at http://www.dodsbir.net/sitis/archives_display_topic.asp?Bookmark=32303. Sandia National Laboratories, "Synthetic Aperture Radar Applications," undated, online at http://www.sandia.gov/radar/sarapps.html; Alicia Tejada, "MIT Develops New Radar Technology: Military Could See Through Walls," ABC News, Oct. 20, 2011, online at http://abcnews.go.com/Technology/radar-technology-mit-walls/story?id=14773871.

recognize and respond to specific people, events, and objects.[19] One of the most significant uses would be to continually track individuals or vehicles as they move about, using face recognition or other bodily characteristics.[20] It might also be used to identify particular movement patterns as "suspicious," or to identify and flag changes in routines, buildings or grounds.[21] Computers performing these tasks have a distinct advantage over human observers, because as one observer summed it up, "machines do not blink or forget. They are tireless assistants."[22]

The PBS series NOVA, "Rise of the Drones," recently aired a segment detailing the capabilities of a powerful aerial surveillance system known as ARGUS-IS. This system, which is basically a super-high, 1.8 gigapixel resolution camera that can be mounted on a drone, demonstrates many of these capacities. The system is capable of high-resolution monitoring and recording of an entire city. To see a demonstration of this capacity please see: http://www.youtube.com/watch?feature=player_embedded&v=13BahrdkMU8

IV. UAVs and Possible Harms

With the federal government likely to permit more widespread use of drones, and the technology likely to become ever more powerful, the question becomes: what role will drones play in American life? Based on current trends—technology development, law enforcement interest, political and industry pressure, and the lack of legal safeguards—it is clear that drones pose a looming threat to Americans' privacy. The reasons for concern reach across a number of different dimensions:

- **Mission creep.** Even where UAVs are being envisioned for search and rescue, fighting wildfires, and in dangerous tactical police operations, they are likely to be quickly embraced by law enforcement around the nation for other, more controversial purposes. The police in Ogden, Utah think that floating a surveillance blimp above their city "will be a deterrent to crime when it is out and about."[23] In Houston, police suggested that drones could possibly be used for writing traffic tickets. [24] The potential result is that they become commonplace in American life.
- **Tracking.** The Justice Department currently claims the authority to monitor Americans' comings and goings using GPS tracking devices—without a warrant. Fleets of UAVs, interconnected and augmented with analytics software, could enable the mass tracking of vehicles and pedestrians around a wide area.

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[19] Vigilant Video, online at http://www.vigilantvideo.com

[20] Noah Shachtman, "Army Tracking Plan: Drones That Never Forget a Face," *Wired.com*, Sept. 28, 2011, online at http://www.wired.com/dangerroom/2011/09/drones-never-forget-a-face/.

[21] On change detection, see Sandia National Laboratories, "Synthetic Aperture Radar Applications," undated, online at http://www.sandia.gov/radar/sarapps.html.

[22] Steve Lohr, "Computers That See You and Keep Watch Over You," *New York Times*, Jan. 1, 2011, online at http://www.nytimes.com/2011/01/02/science/02see.html.

[23] James Nelson, "Utah city may use blimp as anti-crime spy in the sky," Reuters, Jan. 16, 2011, online at http://www.reuters.com/article/2011/01/16/us-crime-blimp-utah-idUSTRE70F1DJ20110116.

[24] Stephen Dean, "Police line up to use drones on patrol after Houston secret test," Houston Examiner, Jan. 11, 2010, online at http://www.examiner.com/page-one-in-houston/police-line-up-to-use-drones-on-patrol-after-houston-secret-test.

- **New uses.** The use of drones could also be expanded from surveillance to actual intervention in law enforcement situations on the ground. Airborne technologies could be developed that could, for example, be used to control or dispel protesters (perhaps by deploying tear gas or other technologies), stop a fleeing vehicle, or even deploy weapons.[25]

In addition, drones raise many of the same issues that pervasive video surveillance brings in any context. For example:

- **Chilling effects.** What would be the effect on our public spaces, and our society as a whole, if everyone felt the keen eye of the government on their backs whenever they ventured outdoors? Psychologists have repeatedly found that people who are being observed tend to behave differently, and make different decisions, than when they are not being watched. This effect is so great that a recent study found that "merely hanging up posters of staring human eyes is enough to significantly change people's behavior."[26]

- **Voyeurism.** Video surveillance is susceptible to individual abuse, including voyeurism. In 2004, a couple making love on a dark nighttime rooftop balcony, where they had every reason to expect they enjoyed privacy, were filmed for nearly four minutes by a New York police helicopter using night vision. This is the kind of abuse that could become commonplace if drone technology enters widespread use. (Rather than apologize, NYPD officials flatly denied that this filming constituted an abuse, telling a television reporter, "this is what police in helicopters are supposed to do, check out people to make sure no one is … doing anything illegal").[27]

- **Discriminatory targeting.** The individuals operating surveillance systems bring to the job all their existing prejudices and biases. In Great Britain, camera operators have been found to focus disproportionately on people of color. According to a sociological study of how the systems were operated, "Black people were between one-and-a-half and two-and-a-half times more likely to be surveilled than one would expect from their presence in the population."[28]

- **Institutional abuse.** In addition to abuse by the inevitable "bad apples" within law enforcement, there is also the danger of institutional abuse. Sometimes, bad policies are

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[25] Joseph Nevins, "Robocop: Drones at Home," Boston Review, January/February 2011, online at http://www.bostonreview.net/BR36.1/nevins.php.

[26] Sander van der Linden, "How the Illusion of Being Observed Can Make You a Better Person," Scientific American, May 3, 2011, online at http://www.scientificamerican.com/article.cfm?id=how-the-illusion-of-being-observed-can-make-you-better-person; M. Ryan Calo, "People Can Be So Fake: A New Dimension to Privacy and Technology Scholarship," 114 Penn St. L. Rev. 809, online at http://www.pennstatelawreview.org/articles/114/114%20Penn%20St.%20L.%20Rev.%20809.pdf.

[27] "Did NYPD Cameras Invade A Couple's Privacy?" WCBS-TV report, Feb. 24, 2005, video no longer available online; Jim Dwyer, "Police Video Caught a Couple's Intimate Moment on a Manhattan Rooftop," *New York Times*, Dec. 22, 2005, online at http://www.nytimes.com/2005/12/22/nyregion/22rooftop.html.

[28] Clive Norris and Gary Armstrong, "The Unforgiving Eye: CCTV Surveillance in Public Spaces," Centre for Criminology and Criminal Justice at Hull University, 1997.

set at the top, and an entire law enforcement agency is turned toward abusive ends. That is especially prone to happen in periods of social turmoil and intense political conflict. During the labor, civil rights, and anti-Vietnam war movements of the 20th century, the FBI and other security agencies engaged in systematic illegal behavior against those challenging the status quo. And once again today we are seeing an upsurge in spying against peaceful political protesters across America.[29]

- **Automated enforcement.** Drones are part of a trend toward automated law enforcement, in which cameras and other technologies are used to mete out justice with little or no human intervention. This trend raises a variety of concerns, such as the fact that computers lack the judgment to fairly evaluate the circumstances surrounding a supposed violation, and may be susceptible to bugs and other software errors, or simply are not programmed to fairly and properly encapsulate the state of the law as passed by legislatures.[30]

One point that is often made about new surveillance technologies is that, while they may increase government surveillance of individuals, they can also increase individuals' ability to record the activities of officials, which can serve as a check on their power. Too often, however, the authorities seek to increase their surveillance over individuals (for example, by installing surveillance cameras throughout public spaces) while restricting individuals' ability to use that same technology as a check against their power (for example, by attempting to prevent individuals from videotaping police[31]). Already, security experts have started expressing concern that unmanned aircraft could be used for terrorism[32]—which naturally raises the question: will individuals be able to make use of the new technology for their own purposes, or will government seek a monopoly over the new technology by citing fears of its use for terrorism?

V. The Fourth Amendment and the Use of Drones

The Supreme Court has never taken a position on whether the Fourth Amendment places limits on government use of UAV surveillance. However, it allowed some warrantless aerial surveillance from *manned* aircraft.

- In the 1986 decision **California v. Ciraolo**, the Supreme Court focused on whether an individual has a privacy interest in being free from aerial surveillance of his backyard. The police had received a tip that Dante Ciraolo was growing marijuana in his backyard, but high fences prevented them from viewing his backyard from the street. The police borrowed a plane, flew it over the backyard and easily spotted marijuana plants growing there. Ciraolo argued that his Fourth Amendment rights were violated because the government did not get a warrant. The Court rejected this argument, explaining that there

[29] See ACLU "Spyfiles" web site at www.aclu.org/spyfiles.
[30] Danielle Keats Citron, "Technological Due Process," 85 Washington University Law Review 1249 (2008), online at http://lawreview.wustl.edu/inprint/85/6/Citron.pdf.
[31] See Jay Stanley, "You Have Every Right to Photograph That Cop," ACLU, online at http://www.aclu.org/free-speech/you-have-every-right-photograph-cop.
[32] Agence France Press, "Flying Robot Attacks 'Unstoppable' Say Experts," Agence France Press, May 11, 2006, available online at http://www.rense.com/general71/sspm.htm.

was no intrusion into his privacy because "[a]ny member of the public flying in this airspace who glanced down could have seen everything that these officers observed."[33]

- **Dow Chemical Co. v. United States**, also decided in 1986, the Supreme Court addressed whether the Environmental Protection Agency violated Dow's Fourth Amendment rights when it employed a commercial aerial photographer to use a precision aerial mapping camera to take photographs of a chemical plant. The Court found no violation, in part because the camera the EPA used was a "conventional, albeit precise, commercial camera commonly used in mapmaking," and "the photographs here are not so revealing of intimate details as to raise constitutional concerns." However, the Court suggested that the use of more sophisticated, intrusive surveillance might justify a different result. It wrote, "surveillance of private property by using highly sophisticated surveillance equipment not generally available to the public, such as satellite technology, might be constitutionally proscribed absent a warrant."[34]

- In **Florida v. Riley**, decided in 1989, the police had received a tip that Michael Riley was growing marijuana in a greenhouse on the property surrounding his home. The interior of the greenhouse was not visible from the ground outside the property, and the greenhouse had a ceiling, though two panels in the ceiling were missing. A police officer flew over the greenhouse and spotted marijuana through the openings in the roof. While no reasoning commanded a majority of the Court, four justices concluded that its decision in *Ciraolo* applied because Riley had left part of the greenhouse open to public view, and so the search was constitutional.[35]

Because of their potential for pervasive use in ordinary law enforcement operations and capacity for revealing far more than the naked eye, drones pose a more serious threat to privacy than do manned flights. There are good reasons to believe that they may implicate Fourth Amendment rights in ways that manned flights do not.

Government use of UAVs equipped with technology that dramatically improves on human vision or captures something humans cannot see (such thermal or x-ray images) should be scrutinized especially closely by the courts. This follows from the Supreme Court's statement in Dow Chemical that using sophisticated technology not generally available to the public may be considered a search under the Fourth Amendment. It is also suggested by the 2001 case *Kyllo v. United States*, in which the court rejected the use of thermal imaging devices to peer into a suspect's home without a warrant.[36]

Further, the Supreme Court has suggested that the pervasive or continuous use of a surveillance technology may heighten Fourth Amendment concerns. In *United States v. Knotts*, the Supreme Court addressed whether attaching primitive "beeper" tracking technology to a car violated the driver's Fourth Amendment rights.[37] Although it concluded that the use of the

[33] 476 U.S. 207 (1986).
[34] 476 U.S. 227 (1986).
[35] 488 U.S. 445 (1989).
[36] 533 U.S. 27 (2001).
[37] 460 U.S. 276, 283-84 (1983).

beeper in that case did not violate the Fourth Amendment, it held that if "such dragnet type law enforcement practices" as "twenty-four hour surveillance of any citizen of this country" ever arose, it would determine if different constitutional principles would be applicable.

Similarly, in *US v. Jones*, decided last year, a concurrence joined by 5 justices found that GPS tracking of a car implicated an individual's reasonable expectation of privacy and noted "society's expectation has been that law enforcement agents and others would not—and indeed, in the main, simply could not—secretly monitor and catalogue every single movement of an individual's car for a very long period."[38] While this decision may eventually play a role in regulating drone usage, the technology is moving far more rapidly than our jurisprudence, and it is critical that Congress not delay action, especially with a looming 2015 deadline set by the FAA Reauthorization Act.

VI. Recommendations

UAVs can be an extremely powerful surveillance tool, and their use must be subject to strict limitations, as should all government power. Like any tool, UAVs have the potential to be used for good or ill. With implementation of good privacy ground rules, our society can enjoy the benefits of this technology without having to worry about its darker potential. Placing reasonable limitations on law enforcement is by no means a new idea. For example authorities may take a thermal image of someone's home only when they get a warrant. Congress should impose appropriate rules, limits and regulations on UAVs as well in order to preserve the privacy Americans have always expected and enjoyed.

At a minimum, Congress should enact the following core measures to ensure that this happens:

- **Usage restrictions.** UAVs should be subject to strict regulation to ensure that their use does not eviscerate the privacy that Americans have traditionally enjoyed and rightly expect. Innocent Americans should not have to worry that their activities will be scrutinized by drones. To this end, the use of drones should be prohibited for indiscriminate mass surveillance, for example, or for spying based on First Amendment-protected activities. In general, drones should not be deployed except:
    - where there are specific and articulable grounds to believe that the drone will collect evidence relating to a specific instance of criminal wrongdoing or, if the drone will intrude upon non-public spaces where the government has obtained a warrant based on probable cause; or
    - where there is a geographically confined, time-limited emergency situation in which particular individuals' lives are at risk, such as a fire, hostage crisis, or person lost in the wilderness; or

[38] 132 S.Ct. 945.

- for reasonable non-law enforcement purposes by non-law enforcement agencies, where privacy will not be substantially affected, such as geological inspections or environmental surveys, and where the surveillance will not be used for secondary law enforcement purposes.

- **Image retention restrictions.** Images of identifiable individuals captured by aerial surveillance technologies should not be retained or shared unless there is reasonable suspicion that the images contain evidence of criminal activity or are relevant to an ongoing investigation or pending criminal trial.

- **Public notice.** The policies and procedures for the use of aerial surveillance technologies should be explicit and written, and should be subject to public review and comment. While it is legitimate for the police to keep the details of particular investigations confidential, policy decisions regarding overall deployment policies—including the privacy trade-offs they may entail—are a public matter that should be openly discussed.

- **Democratic control.** Deployment and policy decisions surrounding UAVs should be democratically decided based on open information—not made on the fly by police departments simply by virtue of federal grants or other autonomous purchasing decisions or departmental policy fiats.

- **Auditing and effectiveness tracking.** Investments in UAVs should only be made with a clear, systematic examination of the costs and benefits involved. And if aerial surveillance technology is deployed, independent audits should be put in place to track the use of UAVs by government, so that citizens and other watchdogs can tell generally how and how often they are being used, whether the original rationale for their deployment is met, whether they represent a worthwhile public expenditure, and whether they are being used for improper or expanded purposes.

- **Ban on weaponization.** Weapons developed on the battlefield in Iraq and Afghanistan have no place inside the U.S. The national consensus on this issue is reflected by the fact that the Heritage Foundation and the International Association of Chiefs of Police join us in supporting sharp limits on weaponized drones.[39]

While this new technology certainly has beneficial uses – for search and rescue missions, firefighting, dangerous police tactical operations – it also poses significant possible harms if left unchecked. Drones should only be used if subject to a powerful framework that regulates their use in order to avoid abuse and invasions of privacy. The ACLU is eager to work with the members of this committee in order to create a robust and appropriate framework for drone use.

[39] International Assocation of Cheifs of Police, Aviation Committee, Recommended Guidelines for the use of Unmanned Aircraft. August 2012, see: http://www.theiacp.org/portals/0/pdfs/IACP_UAGuidelines.pdf; Paul Rosenzweig, Steven P. Bucci, Ph.D., Charles "Cully" Stimson and James Jay Carafano, Ph.D., *Drones in U.S. Airspace: Principles for Governance*, The Heritage Foundation, September 20, 2012, see: http://www.heritage.org/research/reports/2012/09/drones-in-us-airspace-principles-for-governance

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Executive Summary

The purpose of this research is to document the economic benefits to the United States (U.S.) once Unmanned Aircraft Systems (UAS) are integrated into in the National Airspace System (NAS).

In 2012, the federal government tasked the Federal Aviation Administration (FAA) to determine how to integrate UAS into the NAS. In this research, we estimate the economic impact of this integration. In the event that these regulations are delayed or not enacted, this study also estimates the jobs and financial opportunity lost to the economy because of this inaction.

While there are multiple uses for UAS in the NAS, this research concludes that **precision agriculture** and **public safety** are the most promising commercial and civil markets. These two markets are thought to comprise **approximately 90%** of the known potential markets for UAS.

We conclude the following:

1. The economic impact of the integration of UAS into the NAS will total more than $13.6 billion (Table 19) in the first three years of integration and will grow sustainably for the foreseeable future, cumulating to more than $82.1 billion between 2015 and 2025 (Table 1);
2. Integration into the NAS will create more than 34,000 manufacturing jobs (Table 18) and more than 70,000 new jobs in the first three years (Table 19);
3. By 2025, total job creation is estimated at 103,776 (Table 1);
4. The manufacturing jobs created will be high paying ($40,000) and require technical baccalaureate degrees;
5. Tax revenue to the states will total more than $482 million in the first 11 years following integration (2015-2025); and
6. Every year that integration is delayed, the United States loses more than **$10 billion** in potential economic impact. This translates to a loss of **$27.6 million per day that UAS are not integrated into the NAS.**

Utility of UAS

The main inhibitor of U.S. commercial and civil development of the UAS is the lack of a regulatory structure. Because of current airspace restrictions, non-defense use of UAS has been extremely limited. However, the combination of greater flexibility, lower capital and lower operating costs could allow UAS to be a transformative technology in fields as diverse as urban infrastructure management, farming, and oil and gas exploration to name a few.

Present-day UAS have longer operational duration and require less maintenance than earlier models. In addition, they can be operated remotely using more fuel efficient technologies. These aircraft can be deployed in a number of different terrains and may be less dependent on prepared runways. Some argue the use of UAS in the future will be a more responsible approach to certain airspace operations from an environmental, ecological and human risk perspective.

UAS are already being used in a variety of applications, and many more areas will benefit by their use, such as[1]:

- **Wildfire mapping[2];**
- **Agricultural monitoring;**
- **Disaster management;**
- **Thermal infrared power line surveys;**
- **Law enforcement;**
- **Telecommunication;**
- **Weather monitoring;**
- **Aerial imaging/mapping;**
- **Television news coverage, sporting events, moviemaking[3];**
- **Environmental monitoring;**
- **Oil and gas exploration; and**
- **Freight transport.**

Applicable Markets

There are a number of different markets in which UAS can be used. This research is concentrated on the two markets, commercial and civil, with the largest potential. A third category (Other) summarizes all other markets:

1. Precision agriculture;
2. Public safety; and
3. Other.

> While we project more than 100,000 new jobs by 2025, states that create favorable regulatory and business environments for the industry and the technology will likely siphon jobs away from states that do not.

Public safety officials include police officers and professional firefighters in the U.S., as well as a variety of professional and volunteer emergency medical service providers who protect the public from events that pose significant danger, including natural disasters, man-made disasters and crimes.

Precision agriculture refers to two segments of the farm market: remote sensing and precision application. A variety of remote sensors are being used to scan plants for health problems, record growth rates and hydration, and locate disease outbreaks. Such sensors can be attached to ground vehicles, aerial vehicles and even aerospace satellites. Precision application, a practice especially useful for crop farmers and horticulturists, utilizes effective and efficient spray techniques to more selectively cover plants and fields. This allows farmers to provide only the needed pesticide or nutrient to each plant, reducing the total amount sprayed, and thus saving money and reducing environmental impacts.

As listed above, a large number of other markets will also use UAS

[1]Market Intel Group (MiG), November, 2010
[2]Predators improve wildfire mapping: Tests under way to use unmanned aircraft for civilian purposes, Tribune Business News, August 26, 2007
[3]Honeywell International Inc 2004-2012

once the airspace is integrated. We believe the impact of these other markets will be at least the size of the impact from public safety use.

With sensible regulations in place, we foresee few limitations to rapid growth in these industries. These products use off-the-shelf technology and thus impose few problems to rapidly ramping up production. The inputs (i.e., parts) to the UAS can be purchased from more than 100 different suppliers; therefore, prices will be stable and competitive. The inputs to the UAS can all be purchased within the U.S., although these products can be imported from any number of foreign countries without the need of an import license. UAS have a durable life span of approximately 11 years and are relatively easy to maintain. The manufacture of these products requires technical skills equivalent to a baccalaureate degree. Therefore, there will always be a plentiful market of job applicants willing to enter this market. In summary, there are no production problems on the horizon that will impact the manufacturing and output of this product. Most of the barriers of potential usage are governmental and regulatory. For this study, we assume necessary airspace integration in 2015, on par with current legislation.

Covering and justifying the cost of UAS is straightforward. In the precision agriculture market, the average price of the UAS is a fraction of the cost of a manned aircraft, such as a helicopter or crop duster, without any of the safety hazards. For public safety, the price of the product is approximately the price of a police squad car equipped with standard gear. It is also operated at a fraction of the cost of a manned aircraft, such as a helicopter, reducing the strain on agency budgets as well as the risk of bodily harm to the users in many difficult and dangerous situations. Therefore, the cost-benefit ratios of using UAS can be easily understood.

Economic Benefit

The economic benefits to the country are enormous and were estimated as follows. First, we forecast the number of sales in the three market categories. Next, we forecast the supplies needed to manufacture these products. Using estimated costs for labor, we forecast the number of direct jobs created. Using these factors, we forecast the tax revenue to the states.

In addition to direct jobs created by the manufacturing process, there is an additional economic benefit. The new jobs created and the income generated will be spread to local communities. As new jobs are created, additional money is spent at the local level, creating additional demand for local services which, in turn, creates even more jobs (i.e., grocery clerks, barbers, school teachers, home builders, etc.). These indirect and induced jobs are forecast and included in the total jobs created.

The economic benefits to individual states will not be evenly distributed. The following 10 states are predicted to see the most gains in terms of job creation and additional revenue as production of UAS increase, totaling more than $82 billion in economic impact from 2015-2025 (Table 1).

In rank order they are:

1) California
2) Washington
3) Texas
4) Florida
5) Arizona
6) Connecticut
7) Kansas
8) Virginia
9) New York
10) Pennsylvania

It is important to note that the projections contained in this report are based on the current airspace activity and infrastructure in a given state. As a result, states with an already thriving aerospace industry are projected to reap the most economic gains. However, a variety of factors—state laws, tax incentives, regulations, the establishment of test sites and the adoption of UAS technology by end users—will ultimately determine where jobs flow.

By 2025, we estimate more than 100,000 new jobs will be created nationally. For the purposes of this report, we base the 2025 state economic projections on the current aerospace employment in the states. We also presume that none of the states have enacted restrictive legislation or regulations that would limit the expansion of the technology. These landscapes will likely shift, however, as states work to attract UAS jobs in the years following integration. Future state laws and regulations could also cause some states to lose jobs while others stand to gain jobs. In conclusion, while we project more than 100,000 new jobs by 2025, states that create favorable regulatory and business environments for the industry and the technology will likely siphon jobs away from states that do not.

The trend in total spending, total economic impact and total employment impact was investigated for 2015 through 2025. The total spending in UAS development and total economic and employment impacts are expected to increase significantly in the next five years. This study demonstrates the significant contribution of UAS development and integration in the nation's airspace to the economic growth and job creation in the aerospace industry and to the social and economic progress of the citizens in the U.S. See Table 1 for the results of the total impact of UAS integration in the United States.

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Table 1: Total Economic Impact of UAS Integration in the United States						
	2015 - 2017			2015-2025		
State	Economic Impact $(M)	Taxes ($M)	Jobs Created	Economic Impact ($M)	Taxes ($M)	Jobs Created
Alabama	$294	$2.43	1,510	$1,765	$14.60	2,231
Alaska	$19	$0.00	95	$112	$0.00	141
Arizona	$561	$2.59	2,883	$3,371	$15.55	4,260
Arkansas	$80	$0.94	411	$481	$5.63	608
California	$2,390	$13.64	12,292	$14,372	$82.03	18,161
Colorado	$232	$1.79	1,191	$1,392	$10.76	1,760
Connecticut	$538	$4.32	2,764	$3,232	$25.97	4,084
Delaware	$17	$0.16	88	$103	$0.97	131
Florida	$632	$0.00	3,251	$3,801	$0.00	4,803
Georgia	$379	$3.72	1,949	$2,279	$22.34	2,880
Hawaii	$32	$0.39	166	$194	$2.35	245
Idaho	$29	$0.36	149	$174	$2.16	220
Illinois	$204	$1.71	1,049	$1,226	$10.30	1,549
Indiana	$208	$1.18	1,067	$1,248	$7.12	1,577
Iowa	$159	$0.92	817	$956	$5.53	1,208
Kansas	$489	$4.84	2,515	$2,941	$29.13	3,716
Kentucky	$89	$0.90	459	$537	$5.41	678
Louisiana	$213	$1.44	1,097	$1,282	$8.67	1,620
Maine	$107	$1.26	548	$641	$7.56	810
Maryland	$335	$2.64	1,725	$2,017	$15.85	2,549
Massachusetts	$386	$3.36	1,985	$2,321	$20.22	2,933
Michigan	$188	$1.37	965	$1,128	$8.26	1,426
Minnesota	$142	$1.68	730	$853	$10.08	1,078
Mississippi	$162	$1.10	832	$973	$6.60	1,230
Missouri	$260	$1.73	1,338	$1,565	$10.37	1,978
Montana	$14	$0.15	74	$86	$0.91	109
Nebraska	$25	$0.22	128	$149	$1.30	189
Nevada	$38	$0.00	196	$229	$0.00	290
New Hampshire	$85	$0.00	439	$514	$0.00	649
New Jersey	$263	$3.24	1,353	$1,582	$19.50	1,999
New Mexico	$101	$0.73	518	$606	$4.41	765
New York	$443	$4.66	2,276	$2,661	$28.05	3,363
North Carolina	$153	$1.79	785	$918	$10.75	1,160
North Dakota	$14	$0.07	71	$83	$0.40	105
Ohio	$359	$2.43	1,844	$2,156	$14.60	2,725
Oklahoma	$106	$0.93	545	$637	$5.61	805
Oregon	$81	$0.41	416	$486	$2.47	614
Pennsylvania	$393	$2.02	2,021	$2,363	$12.12	2,986
Rhode Island	$42	$0.38	217	$253	$2.28	320
South Carolina	$99	$1.16	507	$593	$6.99	749
South Dakota	$9	$0.00	48	$56	$0.00	71
Tennessee	$112	$0.00	578	$675	$0.00	853
Texas	$1,087	$0.00	5,588	$6,533	$0.00	8,256
Utah	$143	$1.21	735	$859	$7.26	1,085
Vermont	$36	$0.47	184	$215	$2.81	271
Virginia	$463	$4.47	2,380	$2,783	$26.86	3,517
Washington	$1,312	$0.00	6,746	$7,888	$0.00	9,967
West Virginia	$47	$0.47	240	$280	$2.83	354
Wisconsin	$88	$0.96	450	$527	$5.76	665
Wyoming	$5	$0.00	24	$28	$0.00	36
Total	$13,657	$80.22	70,240	$82,124	$482.39	103,776

Forecast

In this chapter, we describe the methodology for the forecasts we used as inputs to the economic benefits section. In accomplishing this task, we were fortunate to obtain and use comparable product sales from other countries. In making the forecasts, we relied on four different methods:

1) Comparable sales from other countries;
2) Survey results;
3) Land ratios; and
4) A literature search on rates of adoption of new technology.

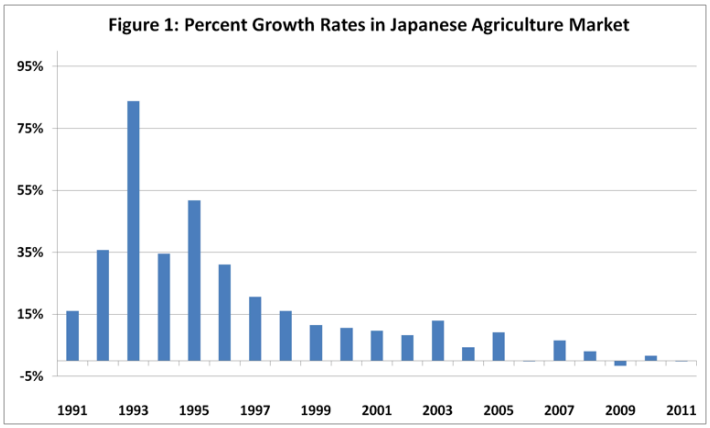
The four different methodologies yielded similar results and provide confidence in our final results.

Throughout this study, we use the following terms. When we use the term output, we are referring to the UAS. The inputs to the UAS are the parts and labor that go into making these products. In turn, the parts that go into the inputs we refer to as derived demand.

As part of this section, we provide a detailed discussion of the factors that may make our forecasts inaccurate and their potential impact. Our forecasts are for an 11-year period. That unit of measurement was chosen as that is the expected life of a UAS. We did not include maintenance, training or other revenue streams, which makes our overall estimates conservative. In addition, there are multiple options on sales including leasing the equipment and having third-party providers as an outsourced service, all of which add to our conservative estimates.

Sales in Foreign Countries

Other countries have already adopted UAS technology from a zero base (i.e., first year of adoption). By now, these technologies have been operational for more than two decades. The growth curve is found to be logistic with a rapid beginning and then a leveling off of the market (Figure 1). The issue is not whether these products will be adopted once the airspace is integrated, but at what rate(s). The experience in Japan started out at rates of growth in excess of 20% annually. This was from no unmanned vehicles in 1990 (i.e., the zero base), where neither the companies nor the consumers had previous experience with this technology (see Appendix A for detailed data).



As is readily apparent, the growth rates in the early years in Japan were very high. The question of interest is: How fast will growth occur in the U.S.? We chose a short time period for growth in the U.S. (doubling the first year, 50% growth the next year and thereafter a 5% growth rate). Our justification is as follows. First, there is considerable experience with these products. American farmers are not starting out from a zero-knowledge base as did Japan. Second, UAS are not sold in the U.S. domestic market only because FAA regulations prohibit them in the nation's airspace. It is noted that the dampening of the Japanese growth curve happened within six years. The literature review found higher initial rates of product acceptance than the previous Japanese experience and lower leveling off of rates.

Adoption Rates of New Technology

There are many factors that influence the rate at which new technologies are adopted and diffused into a society. We found considerable literature on this topic. The conclusion from the brief search we conducted is that new technologies are either accepted or rejected quickly. There is already a trade association that is doing outreach to the primary targets and showing products in their trade show(s). Because there is previous experience in this field, we reject the notion that these products will not be adopted. However, it is suggested that a follow up to this study be conducted on adoption of new technology. There is considerable literature on this topic, which needs to be investigated, and will help develop further adoption strategies.

Methodology

We performed three separate forecasts for this study:

1) The estimated number of sales by state;
2) The estimated sales by state for the inputs to the final product; and
3) The estimated sales by state for the derived demand for the final products.

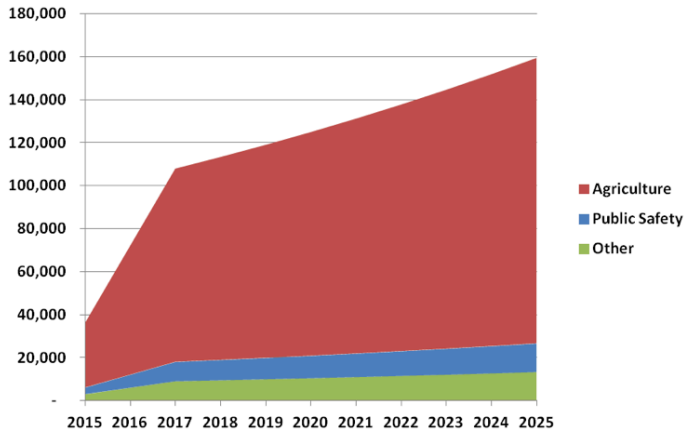
To complete these forecasts, we developed a telephone survey and pilot-tested it on five participants to refine our survey questions. We next conducted 30 telephone interviews with industry experts. An industry expert was defined as a person with more than three years of practical and relevant experience. Each interview lasted about 30 minutes. The participants were guaranteed confidentiality so we cannot divulge the individual results. However, we were able to obtain a reasonable estimate on what the group as a whole felt was the size of the market and the cost structure. Because there was considerable variance in these estimates, we ignored the outliers and calculated the average cost structure. We estimate that approximately 60% of the overall cost of a UAS is parts with an average annual labor cost of $37,000. In this report, we use $40,000 and hold it at a constant cost, as we do with the parts numbers. Thus the results can be interpreted as constant dollars over the entire term, as we are not forecasting the inflation rate. As for profitability, we consider this a competitive industry with a normal rate of return.

We found that almost all respondents considered agriculture to be far and above the largest market given that the public safety market is limited by the number of first-response teams. We next looked at some simple ratios between UAS sales in Japan and the amount of arable farmland and imputed these ratios to the United States. The survey results indicated an agricultural market of approximately 150,000 unit sales per year at maturity (i.e., 2020), and the Japanese land ratio indicated a market size of 165,000 unit sales per year. For the purposes of this forecast, we used 100,000 unit sales per year as a conservative benchmark. See Figure 2 for total expected sales for 2015-2025. Actual sales could be a multiple of this estimate.

As to the public safety market, the consensus was that the agriculture market will be at least 10 times the public safety market. Our follow-up task to the questionnaire was to find the number of first-response domestic teams and survey a small number of this group. We found their purchase issues to be minimal. They simply have a budget given to them by the local governmental unit that oversees them, and they work within it. Purchases of this size are not uncommon and public safety officials have all of the appearances of being early adopters, especially when safety is involved.

During the survey interviews, we discovered that there were unlimited uses of UAS. For example, many respondents discussed the potential uses of UAS for real estate purposes or for examining oil pipelines. In the case of oil pipelines, the consensus of the experts was that the total annual sale was approximately 1,000 units. For real estate personnel, there was not a consensus. From the surveys and follow-up calls with other professionals, we estimate that the aggregate size for other sales was approximately 10% of the total. In reality, this figure is a lower boundary and should be interpreted as at least 10% of the total. Depending on the promotions to this segment, the final price and, most importantly, the federal regulations, this segment could be significantly larger. We estimate the lower boundary at 10% to be conservative.

Figure 2: Annual UAS Sales for Agriculture, Public Safety, and Other Markets



In making the first round of forecasts, we tried several different methods but ultimately used a ratio of the number of direct aerospace and defense (A&D) industry employees in each state[4] to the total number of direct A&D industry employees in the U.S. For example, Alabama has an estimated 23,090 direct A&D industry employees out of a total of 1,040,796 direct A&D employees in the U.S., or 2.22% of the total. So we took the total forecast of agriculture sales and multiplied by 2.22% for Alabama. See Table 2 for a complete list of states and their estimated manufacturing distribution.

For the inputs, we find no constraints. There are plenty of manufacturers of these parts; they are off-the-shelf and require little lead time. If one supply line goes down, there are multiple sources as backups. For the input forecast, we relied on the size of the aerospace labor force in each state as the metric. These numbers were obtained from a Deloitte report, commissioned by the Aerospace Industries Association, titled "The Aerospace and Defense Industry in the U.S.: A Financial and Economic Impact Study"[5]. In this forecast, we also looked at employment and taxes. Using the estimated labor dollar amount, we simply divided by 40,000 to find the number of jobs. Subtracting adjacent years yields the number of new jobs created. We used marginal state tax rates for the $40,000 income range, the assumption being that states will hold this rate constant over time.

Table 2: Estimated Manufacturing Distribution

State	Manufacturing Distribution	State	Manufacturing Distribution
Alabama	2.22%	Montana	0.11%
Alaska	0.15%	Nebraska	0.19%
Arizona	4.10%	Nevada	0.30%
Arkansas	0.61%	New Hampshire	0.67%
California	15.58%	New Jersey	1.99%
Colorado	1.77%	New Mexico	0.78%
Connecticut	3.95%	New York	3.30%
Delaware	0.13%	North Carolina	1.17%
Florida	4.74%	North Dakota	0.11%
Georgia	2.83%	Ohio	2.71%
Hawaii	0.25%	Oklahoma	0.81%
Idaho	0.22%	Oregon	0.63%
Illinois	1.56%	Pennsylvania	3.00%
Indiana	1.59%	Rhode Island	0.32%
Iowa	1.24%	South Carolina	0.76%
Kansas	3.54%	South Dakota	0.07%
Kentucky	0.69%	Tennessee	0.81%
Louisiana	1.65%	Texas	8.43%
Maine	0.82%	Utah	1.10%
Maryland	2.53%	Vermont	0.27%
Massachusetts	2.90%	Virginia	3.55%
Michigan	1.44%	Washington	9.02%
Minnesota	1.09%	West Virginia	0.36%
Mississippi	1.25%	Wisconsin	0.67%
Missouri	1.97%	Wyoming	0.04%

4Deloitte, The Aerospace and Defense Industry in the U.S., A financial and economic impact study, March, 2012
5http://www.deloitte.com/view/en_US/us/Industries/Aerospace-Defense-Manufacturing/b4c8ae98118f5310VgnVCM3000001c56f00aRCRD.htm

Necessary Conditions for the Forecasts

We now turn our attention to the conditions that must happen to validate this forecast:

1) The FAA must develop new regulations integrating UAS into the nation's airspace;
2) Job growth distribution will mimic current aerospace manufacturing employment;
3) Creative destruction of existing jobs will have a net-zero impact;
4) There must be sufficient capital available to smaller manufacturing companies;
5) There must be financing available to UAS purchasers;
6) There must be insurance to cover liabilities;
7) Gross Domestic Product (GDP) needs to grow at least 3% annually over the designated time period;
8) The adoption rate(s) of this product in the U.S. will mimic Japan; and
9) Other unforeseen factors.

The FAA Must Develop New Regulations Integrating UAS into the Nation's Airspace

Perhaps the single most important aspect of this forecast is that the FAA develops new guidelines allowing the integration of UAS in the nation's airspace. In the absence of these guidelines, this report is simply the opportunity cost to the economy (new jobs, tax revenue, etc.) of a good idea that was hindered due to government interference or inaction. The FAA regulatory process, like all government entities, is slow and unpredictable.

Job Growth Distribution Will Mimic Current Aerospace Manufacturing Employment

The employment growth described in this report is all new employment, that is, jobs that do not currently exist. To project the statewide distribution of this employment, we used current aerospace manufacturing employment. However, there are many external factors that will affect this distribution that are impossible to predict in this report. These include, among other things, tax incentives, test sites and where new product development will actually occur.

Creative Destruction of Existing Jobs Will Have a Net Zero Impact

As UAS are introduced, some uses will replace existing capabilities, because there are efficiencies to be gained by using a UAS versus a traditional capability. As such, there is likely to be some job destruction from UAS. However, UAS will still need many similar capabilities to manned systems including training, maintenance and pilots. Any jobs that will be made immaterial by UAS will be transitioned to regular UAS operations. Because of the efficient use of UAS, there will be job creation in other areas. For instance, a farmer that saves money because he or she can use less pesticide since UAS can provide precision application will spend less money on pesticides and less on taxes due to pesticide use. That money back into the farmer's pocket will provide economic impact to the U.S. that is not calculated in this report. To simplify, we generalize that there will be a net-zero impact of job creation in the application of these systems. A detailed analysis of this potential job creation is recommended for further research.

There Must be Sufficient Capital Available to Smaller Manufacturing Companies

One of the biggest problems with growing companies is their access to capital. As companies grow, their need for capital to buy new equipment, hire additional personnel, rent extra space and all of the other requirements are seldom met from working capital. The need for short-term working capital to accommodate growth can stymie any otherwise well thought out business plan.

There Must be Financing Available to UAS Purchasers

While the costs of these purchases are not the same as other farm equipment, they are seldom made as a cash purchase. Farm implements, such as tractors, are usually bought with company financing as they do not have serial numbers like cars. Banks may finance a tractor, but usually at a higher interest rate with the credit worthiness of the person as the collateral. This means that the industry or consortia of companies will need to be created for these purchases. There is probably less of a need for these arrangements for public safety, but they are only a shadow market compared to the agriculture market. It is clear that offering financing from a small company standpoint, outside of normal banking realms, is impossible and impractical at this time. This may be one of the most important factors outside of regulation reform to move this industry forward.

Insurance to Cover Liabilities Must be Supplied

One of the many great unknowns about the infant commercial UAS industry is its product liability exposure. Suppose a UAS used by a public safety agency malfunctions and crashes into a building. The assumption is that this event is covered by the local government's umbrella insurance policy. What if this happens elsewhere? Perhaps the thrust of this argument is that the industry as a whole needs to start collecting relevant data in this realm. A Google search on this topic turned up little information, as governments use UAS mainly for wartime purposes. However, anything mechanical can malfunction, and a UAS is no exception. There will be issues of proper maintenance and liability, as there always are with aircraft of any type, in addition to workmen's compensation and other potential problems. The long-term issue is the need for industry-wide data collection.

GDP Needs to Grow at Least 3% Annually Over the Designated Time Period

All studies of this nature require GDP assumptions. The typical scenario is that over a longer time period, the economy will grow at 3% per year. This is our assumption as well. Our forecast is that with new and improved products, they will grow at a slightly higher rate.

There may be several problems with this assumption. First, the current economic stagnation may persist. If so, this may favor sunken capital over new capital. Thus, we may see growth, but at a much later date, and significantly slower growth thereafter. If this happens, it has the potential to make our forecast inaccurate.

The Adoption Rate(s) of this Product in the U.S. Will Mimic Japan

Consumers in different counties or even different segments of the same country can react differently to the same product offering. Our assumption is that consumers in both countries will react similarly.

Other Unforeseen Factors

Any researcher knows that economic analysis and forecasts may not include hundreds of unforeseen events that impact economic estimates that were not taken into account. Any of these may materially affect our forecast.

Discussion of Forecast Results

In this section, we will discuss the forecast results for the year 2015, which is the first forecast year. Table 3 shows the rank ordering of UAS manufacturing by state for agriculture uses in 2015, and Table 4 shows it for public safety. Other markets besides agriculture and public safety are estimated to have the same total economic impact as the public safety market, so in the following we only show the agriculture and public safety markets. Final economic impact calculations include agriculture, public safety and other markets (i.e., the public safety total economic impact multiplied by two to account for "other markets").

Table 3: 2015 Total UAS Agriculture Sales Inputs

State	Labor	Parts	Taxes	Employment
California	$65,438,414	$ 98,157,622	$2,094,029	1,636
Washington	$37,902,240	$ 56,853,360	$ -	948
Texas	$35,422,907	$ 53,134,361	$ -	886
Florida	$19,927,882	$ 29,891,823	$ -	498
Arizona	$17,225,796	$ 25,838,695	$ 396,882	431
Connecticut	$16,575,698	$ 24,863,547	$ 663,028	414
Virginia	$14,907,071	$ 22,360,607	$ 685,725	373
Kansas	$14,873,981	$ 22,310,972	$ 743,699	372
New York	$13,878,051	$ 20,817,077	$ 716,107	347
Pennsylvania	$12,598,434	$ 18,897,651	$ 309,418	315
Massachusetts	$12,175,124	$ 18,262,685	$ 516,225	304
Georgia	$11,882,156	$ 17,823,233	$ 570,343	297
Ohio	$11,362,400	$ 17,043,599	$ 372,687	284
Maryland	$10,645,314	$ 15,967,971	$ 404,522	266
Alabama	$ 9,317,676	$ 13,976,514	$ 372,707	233
New Jersey	$ 8,353,625	$ 12,530,438	$ 497,876	209
Missouri	$ 8,276,550	$ 12,414,825	$ 264,850	207
Colorado	$ 7,416,208	$ 11,124,313	$ 274,696	185
Louisiana	$ 6,918,647	$ 10,377,970	$ 221,397	173
Indiana	$ 6,686,613	$ 10,029,919	$ 181,876	167
Illinois	$ 6,571,201	$ 9,856,802	$ 262,848	164
Michigan	$ 6,060,323	$ 9,090,485	$ 210,899	152
Mississippi	$ 5,268,583	$ 7,902,874	$ 168,595	132
Iowa	$ 5,193,121	$ 7,789,682	$ 141,253	130
North Carolina	$ 4,898,943	$ 7,348,414	$ 274,341	122
Utah	$ 4,636,240	$ 6,954,360	$ 185,450	116
Minnesota	$ 4,561,989	$ 6,842,984	$ 257,296	114
Maine	$ 3,444,594	$ 5,166,891	$ 192,897	86
Oklahoma	$ 3,410,294	$ 5,115,440	$ 143,232	85
Tennessee	$ 3,390,117	$ 5,085,175	$ -	85
New Mexico	$ 3,271,880	$ 4,907,821	$ 112,553	82
South Carolina	$ 3,185,523	$ 4,778,285	$ 178,389	80
Kentucky	$ 2,877,624	$ 4,316,437	$ 138,126	72
Wisconsin	$ 2,825,568	$ 4,238,352	$ 146,930	71
New Hampshire	$ 2,817,497	$ 4,226,246	$ -	70
Oregon	$ 2,632,274	$ 3,948,411	$ 63,175	66
Arkansas	$ 2,565,690	$ 3,848,535	$ 143,679	64
West Virginia	$ 1,504,791	$ 2,257,186	$ 72,230	38
Rhode Island	$ 1,364,360	$ 2,046,539	$ 58,326	34
Nevada	$ 1,255,001	$ 1,882,501	$ -	31
Vermont	$ 1,150,888	$ 1,726,333	$ 71,815	29
Hawaii	$ 1,041,126	$ 1,561,689	$ 59,969	26
Idaho	$ 932,978	$ 1,399,467	$ 55,232	23
Nebraska	$ 807,478	$ 1,211,217	$ 33,074	20
Alaska	$ 611,763	$ 917,644	$ -	15
Delaware	$ 557,285	$ 835,928	$ 24,743	14
Montana	$ 462,857	$ 694,286	$ 23,328	12
North Dakota	$ 453,576	$ 680,364	$ 10,233	11
South Dakota	$ 305,881	$ 458,822	$ -	8
Wyoming	$ 155,765	$ 233,648	$ -	4

Table 4: 2015 Total UAS Public Safety Sales Inputs

State	Labor	Parts	Taxes	Employment
California	$ 2,804,503	$ 4,206,755	$ 89,744	70
Washington	$ 1,624,382	$ 2,436,573	$ -	41
Texas	$ 1,518,125	$ 2,277,187	$ -	38
Florida	$ 854,052	$ 1,281,078	$ -	21
Arizona	$ 738,248	$ 1,107,373	$ 17,009	18
Connecticut	$ 710,387	$ 1,065,581	$ 28,415	18
Virginia	$ 638,874	$ 958,312	$ 29,388	16
Kansas	$ 637,456	$ 956,184	$ 31,873	16
New York	$ 594,774	$ 892,160	$ 30,690	15
Pennsylvania	$ 539,933	$ 809,899	$ 13,261	13
Massachusetts	$ 521,791	$ 782,687	$ 22,124	13
Georgia	$ 509,235	$ 763,853	$ 24,443	13
Ohio	$ 486,960	$ 730,440	$ 15,972	12
Maryland	$ 456,228	$ 684,342	$ 17,337	11
Alabama	$ 399,329	$ 598,993	$ 15,973	10
New Jersey	$ 358,013	$ 537,019	$ 21,338	9
Missouri	$ 354,709	$ 532,064	$ 11,351	9
Colorado	$ 317,838	$ 476,756	$ 11,773	8
Louisiana	$ 296,513	$ 444,770	$ 9,488	7
Indiana	$ 286,569	$ 429,854	$ 7,795	7
Illinois	$ 281,623	$ 422,434	$ 11,265	7
Michigan	$ 259,728	$ 389,592	$ 9,039	6
Mississippi	$ 225,796	$ 338,695	$ 7,225	6
Iowa	$ 222,562	$ 333,844	$ 6,054	6
North Carolina	$ 209,955	$ 314,932	$ 11,757	5
Utah	$ 198,696	$ 298,044	$ 7,948	5
Minnesota	$ 195,514	$ 293,271	$ 11,027	5
Maine	$ 147,625	$ 221,438	$ 8,267	4
Oklahoma	$ 146,155	$ 219,233	$ 6,139	4
Tennessee	$ 145,291	$ 217,936	$ -	4
New Mexico	$ 140,223	$ 210,335	$ 4,824	4
South Carolina	$ 136,522	$ 204,784	$ 7,645	3
Kentucky	$ 123,327	$ 184,990	$ 5,920	3
Wisconsin	$ 121,096	$ 181,644	$ 6,297	3
New Hampshire	$ 120,750	$ 181,125	$ -	3
Oregon	$ 112,812	$ 169,218	$ 2,707	3
Arkansas	$ 109,958	$ 164,937	$ 6,158	3
West Virginia	$ 64,491	$ 96,737	$ 3,096	2
Rhode Island	$ 58,473	$ 87,709	$ 2,500	1
Nevada	$ 53,786	$ 80,679	$ -	1
Vermont	$ 49,324	$ 73,986	$ 3,078	1
Hawaii	$ 44,620	$ 66,930	$ 2,570	1
Idaho	$ 39,985	$ 59,977	$ 2,367	1
Nebraska	$ 34,606	$ 51,909	$ 1,417	1
Alaska	$ 26,218	$ 39,328	$ -	1
Delaware	$ 23,884	$ 35,825	$ 1,060	1
Montana	$ 19,837	$ 29,755	$ 1,000	0
North Dakota	$ 19,439	$ 29,158	$ 439	0
South Dakota	$ 13,109	$ 19,664	$ -	0
Wyoming	$ 6,676	$ 10,013	$ -	0

The next series of tables we refer to as derived demand. The products that are used as inputs are manufactured by other companies, and the platform manufacturer must buy inputs for their finished goods. Table 5 shows the results for the derived demand for inputs for agriculture and Table 6 for public safety.

Table 5: 2015 Total UAS Agriculture Derived Demand

State	Labor	Parts	Taxes	Employment
California	$39,263,049	$58,894,573	$1,256,418	982
Washington	$22,741,344	$34,112,016	$ -	569
Texas	$21,253,744	$31,880,616	$ -	531
Florida	$11,956,729	$17,935,094	$ -	299
Arizona	$10,335,478	$15,503,217	$ 238,129	258
Connecticut	$ 9,945,419	$14,918,128	$ 397,817	249
Virginia	$ 8,944,243	$13,416,364	$ 411,435	224
Kansas	$ 8,924,389	$13,386,583	$ 446,219	223
New York	$ 8,326,831	$12,490,246	$ 429,664	208
Pennsylvania	$ 7,559,061	$11,338,591	$ 185,651	189
Massachusetts	$ 7,305,074	$10,957,611	$ 309,735	183
Georgia	$ 7,129,293	$10,693,940	$ 342,206	178
Ohio	$ 6,817,440	$10,226,160	$ 223,612	170
Maryland	$ 6,387,188	$ 9,580,782	$ 242,713	160
Alabama	$ 5,590,606	$ 8,385,908	$ 223,624	140
New Jersey	$ 5,012,175	$ 7,518,263	$ 298,726	125
Missouri	$ 4,965,930	$ 7,448,895	$ 158,910	124
Colorado	$ 4,449,725	$ 6,674,588	$ 164,818	111
Louisiana	$ 4,151,188	$ 6,226,782	$ 132,838	104
Indiana	$ 4,011,968	$ 6,017,952	$ 109,126	100
Illinois	$ 3,942,721	$ 5,914,081	$ 157,709	99
Michigan	$ 3,636,194	$ 5,454,291	$ 126,540	91
Mississippi	$ 3,161,150	$ 4,741,725	$ 101,157	79
Iowa	$ 3,115,873	$ 4,673,809	$ 84,752	78
North Carolina	$ 2,939,366	$ 4,409,048	$ 164,604	73
Utah	$ 2,781,744	$ 4,172,616	$ 111,270	70
Minnesota	$ 2,737,193	$ 4,105,790	$ 154,378	68
Maine	$ 2,066,757	$ 3,100,135	$ 115,738	52
Oklahoma	$ 2,046,176	$ 3,069,264	$ 85,939	51
Tennessee	$ 2,034,070	$ 3,051,105	$ -	51
New Mexico	$ 1,963,128	$ 2,944,692	$ 67,532	49
South Carolina	$ 1,911,314	$ 2,866,971	$ 107,034	48
Kentucky	$ 1,726,575	$ 2,589,862	$ 82,876	43
Wisconsin	$ 1,695,341	$ 2,543,011	$ 88,158	42
New Hampshire	$ 1,690,498	$ 2,535,748	$ -	42
Oregon	$ 1,579,364	$ 2,369,046	$ 37,905	39
Arkansas	$ 1,539,414	$ 2,309,121	$ 86,207	38
West Virginia	$ 902,874	$ 1,354,312	$ 43,338	23
Rhode Island	$ 818,616	$ 1,227,924	$ 34,996	20
Nevada	$ 753,001	$ 1,129,501	$ -	19
Vermont	$ 690,533	$ 1,035,800	$ 43,089	17
Hawaii	$ 624,676	$ 937,014	$ 35,981	16
Idaho	$ 559,787	$ 839,680	$ 33,139	14
Nebraska	$ 484,487	$ 726,730	$ 19,845	12
Alaska	$ 367,058	$ 550,586	$ -	9
Delaware	$ 334,371	$ 501,557	$ 14,846	8
Montana	$ 277,714	$ 416,572	$ 13,997	7
North Dakota	$ 272,146	$ 408,218	$ 6,140	7
South Dakota	$ 183,529	$ 275,293	$ -	5
Wyoming	$ 93,459	$ 140,189	$ -	2

Table 6: 2015 Total UAS Public Safety Derived Demand

State	Labor	Parts	Taxes	Employment
California	$ 1,682,702	$2,524,053	$53,846	42
Washington	$ 974,629	$1,461,944	$ -	24
Texas	$ 910,875	$1,366,312	$ -	23
Florida	$ 512,431	$ 768,647	$ -	13
Arizona	$ 442,949	$ 664,424	$10,206	11
Connecticut	$ 426,232	$ 639,348	$17,049	11
Virginia	$ 383,325	$ 574,987	$17,633	10
Kansas	$ 382,474	$ 573,711	$19,124	10
New York	$ 356,864	$ 535,296	$18,414	9
Pennsylvania	$ 323,960	$ 485,940	$ 7,956	8
Massachusetts	$ 313,075	$ 469,612	$13,274	8
Georgia	$ 305,541	$ 458,312	$14,666	8
Ohio	$ 292,176	$ 438,264	$ 9,583	7
Maryland	$ 273,737	$ 410,605	$10,402	7
Alabama	$ 239,597	$ 359,396	$ 9,584	6
New Jersey	$ 214,808	$ 322,211	$12,803	5
Missouri	$ 212,826	$ 319,238	$ 6,810	5
Colorado	$ 190,703	$ 286,054	$ 7,064	5
Louisiana	$ 177,908	$ 266,862	$ 5,693	4
Indiana	$ 171,941	$ 257,912	$ 4,677	4
Illinois	$ 168,974	$ 253,461	$ 6,759	4
Michigan	$ 155,837	$ 233,755	$ 5,423	4
Mississippi	$ 135,478	$ 203,217	$ 4,335	3
Iowa	$ 133,537	$ 200,306	$ 3,632	3
North Carolina	$ 125,973	$ 188,959	$ 7,054	3
Utah	$ 119,218	$ 178,826	$ 4,769	3
Minnesota	$ 117,308	$ 175,962	$ 6,616	3
Maine	$ 88,575	$ 132,863	$ 4,960	2
Oklahoma	$ 87,693	$ 131,540	$ 3,683	2
Tennessee	$ 87,174	$ 130,762	$ -	2
New Mexico	$ 84,134	$ 126,201	$ 2,894	2
South Carolina	$ 81,913	$ 122,870	$ 4,587	2
Kentucky	$ 73,996	$ 110,994	$ 3,552	2
Wisconsin	$ 72,657	$ 108,986	$ 3,778	2
New Hampshire	$ 72,450	$ 108,675	$ -	2
Oregon	$ 67,687	$ 101,531	$ 1,624	2
Arkansas	$ 65,975	$ 98,962	$ 3,695	2
West Virginia	$ 38,695	$ 58,042	$ 1,857	1
Rhode Island	$ 35,084	$ 52,625	$ 1,500	1
Nevada	$ 32,271	$ 48,407	$ -	1
Vermont	$ 29,594	$ 44,391	$ 1,847	1
Hawaii	$ 26,772	$ 40,158	$ 1,542	1
Idaho	$ 23,991	$ 35,986	$ 1,420	1
Nebraska	$ 20,764	$ 31,146	$ 850	1
Alaska	$ 15,731	$ 23,597	$ -	0
Delaware	$ 14,330	$ 21,495	$ 636	0
Montana	$ 11,902	$ 17,853	$ 600	0
North Dakota	$ 11,663	$ 17,495	$ 263	0
South Dakota	$ 7,866	$ 11,798	$ -	0
Wyoming	$ 4,005	$ 6,008	$ -	0

Forecast Conclusion

In this section, we outline the assumptions and methodology used in making our forecasts. We drew on experience in Japan for comparable sales. Japan and the U.S. are both countries that readily adapt new technologies. We conclude the following:

1) If the FAA adopts new rules allowing for commercial use of UAS in the nation's airspace, these products will be received rapidly into the marketplace;

2) The doubling rate can take place over either a three-year or six-year period. With the known rates of change in newer technologies, it is likely to be a three-year scenario given the fact that the potential marketplace is well aware of the product(s) unlike the introduction in Japan; and

3) The commercial agriculture market is by far the largest segment, dwarfing all others.

Agriculture is an important product group. It has the potential for bringing a more reliable, cost-effective and safe method to domestic farmers for a variety of uses. In the event that a new set of regulations is not enacted and UAS are not integrated in the U.S. National Airspace System (NAS), this study estimates the lost jobs, lost tax revenue, and total economic loss to the states and nation. In addition, a delay in airspace integration will impact the U.S. in terms of a lag in technology development, manufacturing, job development and economic stimulus. With U.S. integration of UAS, more than 103,000 good paying jobs with benefits will be created.

While this section shows the huge potential available to the nation, the exact calculations of these benefits are laid out in the next section, where we estimate the total economic impact of NAS integration.

Economic Impact Analysis

Economic impact is based on the theory that a dollar flowing into a local economy from the outside is a benefit to the regional economy. The financial return for residents is in the form of new jobs, more earnings and new tax revenues that follow because of the initial development of a new business organization, and through new spending, in the municipality due to the operation of such a business or industry. These earnings, for instance, are generated for residents who are not directly associated with the business but who are the beneficiaries of the positive externalities that the business or industry can provide to communities.

External benefits, or positive externalities, are those returns that are generated by a business but that are not captured by the business or local region. When the employees of a company spend money at local businesses, such as restaurants, gas stations and retail stores, their spending will benefit the owners and employees of those establishments, thereby creating a positive incremental impact.

According to Davis (1990) an impact analysis is purposely designed to produce quantitative results of the effects that a certain segment of an industry has in the local economy. From an industry's standpoint, these impact studies are based on the grounds of aggregate economic growth that may be derived from additional spending by the business. The range of the impact can be limited to the city, county, state or national levels.

There are various methodologies that aid the economic valuation of specific organizations in their local economies. From the literature review, we concluded that Economic Impact Analysis (EIA) mostly relies on input-output economic models. Economists evaluate the impact that one sector has on another in terms of indirect and induced effects. The total economic impact is then the sum of the direct, indirect and induced effects.

Direct Impacts

Direct impacts are consequences of economic activities carried out by a company or organization in the economy. For example, institutions (public or private) have a direct impact on the local economy because of the activities conducted by the institution, management, employees, visitors and other related events. Employing labor, purchasing locally produced goods and services, and contracting for construction and capital improvements are all examples of activities that generate direct impacts. Some direct impacts, such as UAS, occur on site. Others, such as local production of goods and services for use at the institution, may occur off site.

Expenditures by management, owners and visitors also generate direct impacts, but only those expenditures that lead to local business activity are relevant for a regional economic assessment. For this reason, it is important to distinguish between (a) the local value-added component of expenditures and (b) the regional import component. Thus, the manufacturers of UAS expenditures on utilities, supplies, professional services, meals and entertainment generate significant economic benefits to the local and national economy. In most parts of the country, only the former component is relevant for the analysis. The following is a list of local value-added components:

- Direct Spending Effects:
  Construction, maintenance, operations
- Direct Business Cost Savings:
  Value of user benefits
- Other Business Cost Savings:
  Logistics/inventory/ processing, scale economies
- Regional Business Markets:
  Tourism, business relocation effects
- Personal Cost Savings:
  Effect on disposable income

The distinguishing feature of a direct impact is that it is an immediate consequence of the manufacturers of UAS' economic activity.

Indirect Impacts

In addition to the direct effect of an economic activity, there are also indirect effects and induced effects. Indirect impacts derive from off-site economic activities that are attributable to the business activities of the manufacturers of UAS' presence. For example, if we are looking at the job impacts of a new UAS being manufactured in Arizona, the direct effect is the number of new jobs created by the company itself. The indirect effect is the number of new jobs created at those firms that supply ancillary services for individuals who are employed at the UAS manufacturing facility and for customers of the firm. These can include, but are not limited to, hotels, restaurants and other businesses that may expand because of the presence of the UAS manufacturing facility. These suppliers and clients employ labor, purchase locally produced goods and services, and invest in capital expansion and improvements. Indirect impacts differ from direct impacts in that they originate entirely off site.

Examples of indirect impacts would be:

- Ancillary business expansion due to the UAS firm;
- New capital investment in response to the UAS firm; and
- Supplies and equipment that may be purchased because of the new business opportunities created by the UAS manufacturing facility.

Induced Impacts

Induced impacts are the result of spending of the wages and salaries of the direct and indirect employees on items such as food, housing, transportation and medical services. In other words, induced effects are the multiplier effects caused by successive rounds of spending throughout the economy as a result of the direct and indirect effects discussed above.

For example, most of the take-home income earned by the manu-

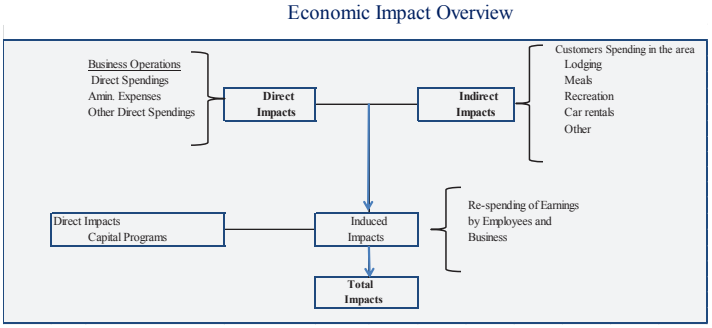
facturers of UAS employees is spent locally. Some of this spending becomes income to local businesses and their employees that provide services to the firm's employees. Then part of these second-round incomes are also spent locally and thus become income to another set of individuals. As successive rounds of spending occur, additional income is created. Although some of the induced impacts occur locally, some are felt outside the region because of the regional import components of the goods and services purchased. More economically self-sufficient regions have higher multipliers than do regions that are more dependent on regional imports, because more of the spending and respending is accomplished in the area. Similarly, two or more counties considered together as one economic region would have a higher multiplier than would each individual county.

Total Impact

The total impact is the sum of direct impacts, indirect impacts and induced impacts. Total impact is expressed in economic output, earnings or jobs.

Total Impacts = Direct Impacts + Indirect Impacts + Induced Impacts

Economic Impact Overview



Economists sometimes say that the direct economic impacts are "multiplied" through their indirect economic impacts. The ratio of the total (direct + indirect) economic impacts to the direct economic impacts is frequently referred to as the economic multiplier. The employment multiplier is the ratio of total employment to direct employment. The income multiplier is the ratio of total income to direct income created.

Multipliers are not directly observed; rather, they are inferred from an economic model. The direct measure is generally the most accurate since it can be measured more easily, but it only represents a part of the impact, so other multipliers are added to get the total. However, it should be emphasized that the sum of the multipliers is very important since these are virtually the only tools available to researchers attempting to identify the overall impact of activity within a regional economy.

Although a variety of methods can be used to generate economic multipliers, input-output (I-O) models are the most popular tool for such analysis and will be our focus. IMPLAN is a standard economic impact software package used to generate indirect, induced employment and sales estimates. IMPLAN utilizes user-supplied estimates of the direct sales and/or employment and provides associated indirect and induced effects estimates. Direct effects are the changes in the industries to which a final demand change was made; indirect effects are the changes in interindustry purchases as the response to demand of the directly affected industry; and induced effects generally reflect changes in household spending resulting from activity generated by the direct and indirect effects (MIG, p.102).

$$Multiplier = \frac{indirect\ impacts}{direct\ impacts}$$

Previous Economic Impact Studies

Conducting an economic impact study is important, because it is a useful tool to evaluate the economic impact of a business in a community in terms of jobs, income and tax revenue. Ten studies were selected from the literature to illustrate the different facets of economic impact and approaches used to assess impact. The purpose is to illustrate the range of values that may be achieved by different economic entities. The 10 examples are listed below:

- Marshall County Hospital Impact in Marshall County, Kentucky;
- Port of Baltimore impact in Maryland;
- University of Florida in Florida;
- Intel impact in Washington County;
- Intel impact in Oregon;
- Intel impact in Portland, Oregon Metro;
- Boeing impact in Arizona;
- All Acute Care Hospital Systems impact in New Hampshire;
- National Aeronautics and Space Administration (NASA) impact in Florida; and
- Nike impact in Oregon.

Methodology

The aircraft industry, undoubtedly, provides significant economic and social benefits for the regional, state and national economies. Most economic impact analyses utilize input-output models to provide detailed descriptions on how money invested in an economy travels and, through multiplier effects, creates additional employment and income. The basis of these input-output models is a summation of expenditures of the manufacturer (operations, capital and payroll) and the application of the multipliers to account for the interdependency of economic activity in a local economy (Siegfried et al., 2007). There are two well-known input-output programs: Regional Input-Output Modeling System (RIMS II) and the more advanced Impact Analysis for Planning (IMPLAN) software.

To more effectively use the multipliers for impact analysis, users must provide geographically and industrially detailed information

on the initial changes in output, earnings or employment that are associated with the project or program under study.

RIMS II was developed by the Bureau of Economic Analysis (BEA) and is based on an accounting framework called an I-O table, which shows the industrial distribution of inputs purchased and outputs sold for each industry (BEA, 2010). There are two sources for the I-O table: BEA's national I-O table, which shows the input and output structure of nearly 500 U.S. industries, and BEA's regional economic accounts, which are used to adjust the national I-O table to show a region's industrial structure and trading patterns. RIMS II has several advantages:

- Multipliers can be estimated for any region and for any industry;
- Low-cost estimates of regional multipliers because of data source accessibility are available; and
- Expensive surveys and RIMS II-based estimates are similar in magnitude.

IMPLAN is a more specialized software; it captures the actual dollar amounts of all business transactions taking place in a regional economy by utilizing Social Accounting Matrices (SAMs) accounts (IMPLAN, 2011). IMPLAN's advantages are:

- SAMs are a better measure of economic flow as they include "nonmarket" transactions (i.e., taxes and unemployment benefits);
- Multiplier Models are built directly from the region-specific SAMs, which reflect the region's unique structure;
- Trade Flows Method tracks regional purchases by estimating trade flows, allowing for more accurate capturing of indirect effects; and
- Data accessibility is cost effective and efficient.

For this study, we have utilized IMPLAN's input-output software to estimate the direct, indirect and induced effects of UAS integration in the NAS upon the local economy. The estimated economic impacts of this integration for each of the 50 states are provided in Appendix B.

Data

The most common economic measures used in economic impact analysis are:

- Employment [broken down to include full-time equivalents (FTEs)];
- Annual labor income;
- Taxes; and
- Total output or revenue.

This analysis is based on the following data provided by our own forecasts for the 50 states from 2015 through 2025:

1) Total spending by agriculture and public safety in payroll, parts, and taxes;
2) Total direct employment by agriculture and public safety; and
3) State adjustment factors.

Results

For this study, we used IMPLAN's input-output software to estimate the direct, indirect, induced and total effects of UAS integration on the economy of the state of Arizona. Because of the unique nature of manufacturing UAS and the specialized type of workers required, specific project payroll, parts, and taxes for agriculture and public safety were provided. Using the parts manufacturing distribution data in Table 7, we subtracted 4.10% (Arizona) from all values to get a distribution relative to Arizona. We then used this to modify the existing IMPLAN model for the rest of the states. Table 7 shows the adjustment factors to modify the multipliers for all states based on the Arizona multipliers that were derived from the IMPLAN's input output software.

Table 7: State Multiplier Adjustment Factors Based on State of Arizona's Multiplier

State	Abbreviation	Adjustment Factors	State	Abbreviation	Adjustment Factors
Alabama	AL	-1.88%	Montana	MT	-3.99%
Alaska	AK	-3.96%	Nebraska	NE	-3.91%
Arizona	AZ	0.00%	Nevada	NV	-3.80%
Arkansas	AR	-3.49%	New Hampshire	NH	-3.43%
California	CA	11.48%	New Jersey	NJ	-2.11%
Colorado	CO	-2.34%	New Mexico	NM	-3.32%
Connecticut	CT	-0.15%	New York	NY	-0.80%
Delaware	DE	-3.97%	North Carolina	NC	-2.93%
Florida	FL	0.64%	North Dakota	ND	-3.99%
Georgia	GA	-1.27%	Ohio	OH	-1.40%
Hawaii	HI	-3.85%	Oklahoma	OK	-3.29%
Idaho	ID	-3.88%	Oregon	OR	-3.47%
Illinois	IL	-2.54%	Pennsylvania	PA	-1.10%
Indiana	IN	-2.51%	Rhode Island	RI	-3.78%
Iowa	IA	-2.86%	South Carolina	SC	-3.34%
Kansas	KS	-0.56%	South Dakota	SD	-4.03%
Kentucky	KY	-3.42%	Tennessee	TN	-3.29%
Louisiana	LA	-2.45%	Texas	TX	4.33%
Maine	ME	-3.28%	Utah	UT	-3.00%
Maryland	MD	-1.57%	Vermont	VT	-3.83%
Massachusetts	MA	-1.20%	Virginia	VA	-0.55%
Michigan	MI	-2.66%	Washington	WA	4.92%
Minnesota	MN	-3.02%	West Virginia	WV	-3.74%
Mississippi	MS	-2.85%	Wisconsin	WI	-3.43%
Missouri	MO	-2.13%	Wyoming	WY	-4.06%

Total Economic and Employment Impacts of Agriculture Spending

Table 8 presents the estimated total economic and employment impacts of agriculture spending in all 50 states in 2015. The total economic impact in all 50 states is $2,096.5 million with total job creation of 21,565. The state with the largest economic and employment impacts is California with a total economic impact of about $366.9 million and creation of 3,774 new jobs. Following California are Washington, Texas, Florida and Arizona. The state with the least economic and employment impacts is Wyoming with an estimated $723,647 and creation of seven new jobs.

The average economic and employment impacts of agriculture spending per state are $41,929,742 and creation of 431 new jobs. The standard deviation of economic and employment impacts of agriculture spending are $61,565,404 and 633 new jobs. The large standard deviation indicates the wide variability (spread) of economic and employment impacts among states.

Total Economic and Employment Impacts of Public Safety and Other Spending

Table 9 presents the estimated total economic and employment impacts in 2015 of public safety spending in all 50 states. Since the total spending for "other markets" is considered equivalent to the public safety estimates, these data are not repeated. The total economic impact of the public safety market in all 50 states is approximately $89.8 million with creation of 924 new jobs. As with agriculture spending, the state with the largest economic and employment impacts is California with a total of more than $15.7 million and creation of 162 new jobs. This is followed in descending order by the states of Washington, Texas, Florida and Arizona. The state of Wyoming has the least economic and employment impacts with $31,013 and no new jobs created.

The average economic and employment impacts of public safety spending per state are $1,796,989 and creation of 18 new jobs. The standard deviation of economic and employment impacts of public safety spending is $2,638,517 and creation of 27 new jobs. The large standard deviation again indicates the wide variability among states.

Table 8: 2015 Total Economic & Employment Impacts of Agriculture Spending

State	Direct Spending				State Total Multipliers	Total Economic Impact	Total Employment Impact
	Payroll	Parts	Taxes	Total			
Alabama	$9,317,676	$13,976,514	$372,707	$23,666,897	1.9043	$45,068,872	464
Alaska	$611,763	$917,644	$0	$1,529,406	1.8623	$2,848,213	29
Arizona	$17,225,796	$25,838,695	$396,882	$43,461,373	1.9800	$86,053,519	885
Arkansas	$2,565,690	$3,848,535	$143,679	$6,557,904	1.8718	$12,275,085	126
California	$65,438,414	$98,157,622	$2,094,029	$165,690,065	2.2143	$366,887,512	3,774
Colorado	$7,416,208	$11,124,313	$274,696	$18,815,217	1.8893	$35,547,590	366
Connecticut	$16,575,698	$24,863,547	$663,028	$42,102,272	1.9598	$82,512,034	849
Delaware	$557,285	$835,928	$24,743	$1,417,956	1.8594	$2,636,547	27
Florida	$19,927,882	$29,891,823	$0	$49,819,705	1.9477	$97,033,840	998
Georgia	$11,882,156	$17,823,233	$570,343	$30,275,732	1.9216	$58,177,847	598
Hawaii	$1,041,126	$1,561,689	$59,969	$2,662,784	1.8604	$4,953,844	51
Idaho	$932,978	$1,399,467	$55,232	$2,387,678	1.8602	$4,441,558	46
Illinois	$6,571,201	$9,856,802	$262,848	$16,690,851	1.8750	$31,295,346	322
Indiana	$6,686,613	$10,029,919	$181,876	$16,898,408	1.8850	$31,853,499	328
Iowa	$5,193,121	$7,789,682	$141,253	$13,124,056	1.8589	$24,396,309	251
Kansas	$14,873,981	$22,310,972	$743,699	$37,928,652	1.9792	$75,068,387	772
Kentucky	$2,877,624	$4,316,437	$138,126	$7,332,187	1.8681	$13,697,259	141
Louisiana	$6,918,647	$10,377,970	$221,397	$17,518,014	1.8684	$32,730,657	337
Maine	$3,444,594	$5,166,891	$192,897	$8,804,383	1.8584	$16,362,066	168
Maryland	$10,645,314	$15,967,971	$404,522	$27,017,806	1.9061	$51,498,641	530
Massachusetts	$12,175,124	$18,262,685	$516,225	$30,954,034	1.9142	$59,252,213	609
Michigan	$6,060,323	$9,090,485	$210,899	$15,361,707	1.8748	$28,800,128	296
Minnesota	$4,561,989	$6,842,984	$257,296	$11,662,269	1.8677	$21,781,620	224
Mississippi	$5,268,583	$7,902,874	$168,595	$13,340,052	1.8621	$24,840,511	256
Missouri	$8,276,550	$12,414,825	$264,850	$20,956,224	1.9064	$39,950,946	411
Montana	$462,857	$694,286	$23,328	$1,180,471	1.8589	$2,194,378	23
Nebraska	$807,478	$1,211,217	$33,074	$2,051,770	1.8600	$3,816,291	39
Nevada	$1,255,001	$1,882,501	$0	$3,137,502	1.8666	$5,856,462	60
New Hampshire	$2,817,497	$4,226,246	$0	$7,043,743	1.8612	$13,109,815	135
New Jersey	$8,353,625	$12,530,438	$497,876	$21,381,940	1.8883	$40,375,517	415
New Mexico	$3,271,880	$4,907,821	$112,553	$8,292,254	1.8642	$15,458,419	159
New York	$13,878,051	$20,817,077	$716,107	$35,411,235	1.9184	$67,932,913	699
North Carolina	$4,898,943	$7,348,414	$274,341	$12,521,698	1.8711	$23,429,348	241
North Dakota	$453,576	$680,364	$10,233	$1,144,172	1.8585	$2,126,445	22
Ohio	$11,362,400	$17,043,599	$372,687	$28,778,686	1.9129	$55,050,748	566
Oklahoma	$3,410,294	$5,115,440	$143,232	$8,668,966	1.8753	$16,256,913	167
Oregon	$2,632,274	$3,948,411	$63,175	$6,643,859	1.8685	$12,414,050	128
Pennsylvania	$12,598,434	$18,897,651	$309,418	$31,805,503	1.8964	$60,315,956	620
Rhode Island	$1,364,360	$2,046,539	$58,326	$3,469,225	1.8638	$6,465,942	67
South Carolina	$3,185,523	$4,778,285	$178,389	$8,142,198	1.8585	$15,132,275	156
South Dakota	$305,881	$458,822	$0	$764,703	1.8673	$1,427,930	15
Tennessee	$3,390,117	$5,085,175	$0	$8,475,292	2.0342	$17,240,439	177
Texas	$35,422,907	$53,134,361	$0	$88,557,268	1.8834	$166,788,758	1,716
Utah	$4,636,240	$6,954,360	$185,450	$11,776,049	1.8619	$21,925,827	226
Vermont	$1,150,888	$1,726,333	$71,815	$2,949,036	1.8578	$5,478,720	56
Virginia	$14,907,071	$22,360,607	$685,725	$37,953,403	1.8720	$71,048,771	731
Washington	$37,902,240	$56,853,360	$0	$94,755,601	2.1250	$201,355,651	2,071
West Virginia	$1,504,791	$2,257,186	$72,230	$3,834,206	1.8662	$7,155,396	74
Wisconsin	$2,825,568	$4,238,352	$146,930	$7,210,850	1.8642	$13,442,466	138
Wyoming	$155,765	$233,648	$0	$389,413	1.8583	$723,647	7
TOTAL	$420,000,000	$630,000,000	$12,314,681	$1,062,314,681		$2,096,487,120	21,565
Average						$41,929,742	431
STD						$61,565,404	633

Table 9: 2015 Total Economic & Employment Impacts of Public Safety Spending

State	Direct Spending				State Total Multipliers	Total Economic Impact	Total Employment Impact
	Payroll	Parts	Taxes	Total			
Alabama	$399,329	$598,993	$15,973	$1,014,296	1.9043	$1,931,523	20
Alaska	$26,218	$39,328	$0	$65,546	1.8623	$122,066	1
Arizona	$738,248	$1,107,373	$17,009	$1,862,630	1.9800	$3,688,008	38
Arkansas	$109,958	$164,937	$6,158	$281,053	1.8718	$526,075	5
California	$2,804,503	$4,206,755	$89,744	$7,101,003	2.2143	$15,723,751	162
Colorado	$317,838	$476,756	$11,773	$806,366	1.8893	$1,523,468	16
Connecticut	$710,387	$1,065,581	$28,415	$1,804,383	1.9598	$3,536,230	36
Delaware	$23,884	$35,825	$1,060	$60,770	1.8594	$112,995	1
Florida	$854,052	$1,281,078	$0	$2,135,130	1.9477	$4,158,593	43
Georgia	$509,235	$763,853	$24,443	$1,297,531	1.9216	$2,493,336	26
Hawaii	$44,620	$66,930	$2,570	$114,119	1.8604	$212,308	2
Idaho	$39,985	$59,977	$2,367	$102,329	1.8602	$190,353	2
Illinois	$281,623	$422,434	$11,265	$715,322	1.8750	$1,341,229	14
Indiana	$286,569	$429,854	$7,795	$724,217	1.8850	$1,365,150	14
Iowa	$222,562	$333,844	$6,054	$562,460	1.8589	$1,045,556	11
Kansas	$637,456	$956,184	$31,873	$1,625,514	1.9792	$3,217,217	33
Kentucky	$123,327	$184,990	$5,920	$314,237	1.8681	$587,025	6
Louisiana	$296,513	$444,770	$9,488	$750,772	1.8684	$1,402,742	14
Maine	$147,625	$221,438	$8,267	$377,331	1.8584	$701,231	7
Maryland	$456,228	$684,342	$17,337	$1,157,906	1.9061	$2,207,085	23
Massachusetts	$521,791	$782,687	$22,124	$1,326,601	1.9142	$2,539,381	26
Michigan	$259,728	$389,592	$9,039	$658,359	1.8748	$1,234,291	13
Minnesota	$195,514	$293,271	$11,027	$499,812	1.8677	$933,498	10
Mississippi	$225,796	$338,695	$7,225	$571,717	1.8621	$1,064,593	11
Missouri	$354,709	$532,064	$11,351	$898,124	1.9064	$1,712,183	18
Montana	$19,837	$29,755	$1,000	$50,592	1.8589	$94,045	1
Nebraska	$34,606	$51,909	$1,417	$87,933	1.8600	$163,555	2
Nevada	$53,786	$80,679	$0	$134,464	1.8666	$250,991	3
New Hampshire	$120,750	$181,125	$0	$301,875	1.8612	$561,849	6
New Jersey	$358,013	$537,019	$21,338	$916,369	1.8883	$1,730,379	18
New Mexico	$140,223	$210,335	$4,824	$355,382	1.8642	$662,504	7
New York	$594,774	$892,160	$30,690	$1,517,624	1.9184	$2,911,411	30
North Carolina	$209,955	$314,932	$11,757	$536,644	1.8711	$1,004,115	10
North Dakota	$19,439	$29,158	$439	$49,036	1.8585	$91,133	1
Ohio	$486,960	$730,440	$15,972	$1,233,372	1.9129	$2,359,318	24
Oklahoma	$146,155	$219,233	$6,139	$371,527	1.8753	$696,725	7
Oregon	$112,812	$169,218	$2,707	$284,737	1.8685	$532,031	5
Pennsylvania	$539,933	$809,899	$13,261	$1,363,093	1.8964	$2,584,970	27
Rhode Island	$58,473	$87,709	$2,500	$148,681	1.8638	$277,112	3
South Carolina	$136,522	$204,784	$7,645	$348,951	1.8585	$648,526	7
South Dakota	$13,109	$19,664	$0	$32,773	1.8673	$61,197	1
Tennessee	$145,291	$217,936	$0	$363,227	2.0342	$738,876	8
Texas	$1,518,125	$2,277,187	$0	$3,795,311	1.8834	$7,148,090	74
Utah	$198,696	$298,044	$7,948	$504,688	1.8619	$939,678	10
Vermont	$49,324	$73,986	$3,078	$126,387	1.8578	$234,802	2
Virginia	$638,874	$958,312	$29,388	$1,626,574	1.8720	$3,044,947	31
Washington	$1,624,382	$2,436,573	$0	$4,060,954	2.1250	$8,629,528	89
West Virginia	$64,491	$96,737	$3,096	$164,323	1.8662	$306,660	3
Wisconsin	$121,096	$181,644	$6,297	$309,036	1.8642	$576,106	6
Wyoming	$6,676	$10,013	$0	$16,689	1.8583	$31,013	0
TOTAL	$18,000,000	$27,000,000	$527,772	$45,527,772		$89,849,448	924
Average						$1,796,989	18
STD						$2,638,517	27
MAX						$15,723,751	162
MIN						$31,013	0

Total Economic and Employment Impacts of Agriculture, Public Safety and Other Spending

Table 10 presents the estimated total economic and employment impacts of agriculture, public safety and other spending in 2015 all 50 states. The total economic impact of these markets in all 50 states is more than $2,276 million with total job creation of 23,413. The state with the largest economic and employment impact is California with a total of more than $398.3 million and creation of 4,097 new jobs. Following California in descending rank order are Washington, Texas, Florida and Arizona. In addition, the order of job creation was similar to estimated total economic impact. Wyoming has the least economic and employment impacts with $785,674 and eight new jobs created.

The average economic and employment impacts of agriculture, public safety and other spending per state are approximately $45.5 million and creation of 468 new jobs. The standard deviation of economic and employment impacts is approximately $66.8 million and 688 new jobs created. As with agriculture, public safety and other state estimates, there is a wide variability of economic and employment impacts and job creation among states.

Table 10: 2015 Total Economic & Employment Impacts of Agriculture, Public Safety and Other Spending

State	Direct Spending				State Total Multipliers	Total Economic Impact	Total Employment Impact
	Payroll	Parts	Taxes	Total			
Alabama	$10,116,334	$15,174,501	$404,653	$25,695,488	1.9043	$48,931,919	503
Alaska	$664,199	$996,299	$0	$1,660,498	1.8623	$3,092,346	32
Arizona	$18,702,293	$28,053,440	$430,901	$47,186,634	1.9800	$93,429,535	961
Arkansas	$2,785,606	$4,178,410	$155,994	$7,120,010	1.8718	$13,327,235	137
California	$71,047,421	$106,571,132	$2,273,517	$179,892,071	2.2143	$398,335,013	4,097
Colorado	$8,051,883	$12,077,825	$298,242	$20,427,950	1.8893	$38,594,526	397
Connecticut	$17,996,472	$26,994,708	$719,859	$45,711,039	1.9598	$89,584,494	921
Delaware	$605,052	$907,578	$26,864	$1,539,495	1.8594	$2,862,537	29
Florida	$21,635,986	$32,453,979	$0	$54,089,966	1.9477	$105,351,026	1,084
Georgia	$12,900,626	$19,350,939	$619,230	$32,870,795	1.9216	$63,164,520	650
Hawaii	$1,130,366	$1,695,548	$65,109	$2,891,023	1.8604	$5,378,459	55
Idaho	$1,012,948	$1,519,422	$59,967	$2,592,336	1.8602	$4,822,263	50
Illinois	$7,134,447	$10,701,671	$285,378	$18,121,496	1.8750	$33,977,804	350
Indiana	$7,259,751	$10,889,627	$197,465	$18,346,843	1.8850	$34,583,799	356
Iowa	$5,638,246	$8,457,369	$153,360	$14,248,976	1.8589	$26,487,421	272
Kansas	$16,148,894	$24,223,341	$807,445	$41,179,679	1.9792	$81,502,821	838
Kentucky	$3,124,278	$4,686,417	$149,965	$7,960,660	1.8681	$14,871,309	153
Louisiana	$7,511,674	$11,267,511	$240,374	$19,019,558	1.8684	$35,536,142	366
Maine	$3,739,845	$5,609,768	$209,431	$9,559,045	1.8584	$17,764,528	183
Maryland	$11,557,769	$17,336,654	$439,195	$29,333,618	1.9061	$55,912,810	575
Massachusetts	$13,218,706	$19,828,059	$560,473	$33,607,237	1.9142	$64,330,974	662
Michigan	$6,579,779	$9,869,669	$228,976	$16,678,425	1.8748	$31,268,710	322
Minnesota	$4,953,017	$7,429,525	$279,350	$12,661,892	1.8677	$23,648,616	243
Mississippi	$5,720,176	$8,580,264	$183,046	$14,483,485	1.8621	$26,969,697	277
Missouri	$8,985,968	$13,478,953	$287,551	$22,752,472	1.9064	$43,375,313	446
Montana	$502,531	$753,796	$25,328	$1,281,654	1.8589	$2,382,467	25
Nebraska	$876,691	$1,315,036	$35,909	$2,227,636	1.8600	$4,143,402	43
Nevada	$1,362,572	$2,043,859	$0	$3,406,431	1.8666	$6,358,445	65
New Hampshire	$3,058,997	$4,588,496	$0	$7,647,493	1.8612	$14,233,514	146
New Jersey	$9,069,651	$13,604,476	$540,551	$23,214,678	1.8883	$43,836,276	451
New Mexico	$3,552,327	$5,328,491	$122,200	$9,003,018	1.8642	$16,783,427	173
New York	$15,067,598	$22,601,397	$777,488	$38,446,484	1.9184	$73,755,734	759
North Carolina	$5,318,852	$7,978,278	$297,856	$13,594,986	1.8711	$25,437,578	262
North Dakota	$492,454	$738,681	$11,110	$1,242,244	1.8585	$2,308,711	24
Ohio	$12,336,320	$18,504,479	$404,631	$31,245,430	1.9129	$59,769,383	615
Oklahoma	$3,702,605	$5,553,907	$155,509	$9,412,021	1.8753	$17,650,363	182
Oregon	$2,857,897	$4,286,846	$68,590	$7,213,333	1.8685	$13,478,112	139
Pennsylvania	$13,678,300	$20,517,450	$335,939	$34,531,689	1.8964	$65,485,895	674
Rhode Island	$1,481,305	$2,221,957	$63,326	$3,766,588	1.8638	$7,020,166	72
South Carolina	$3,458,568	$5,187,852	$193,680	$8,840,100	1.8585	$16,429,327	169
South Dakota	$332,100	$498,149	$0	$830,249	1.8673	$1,550,324	16
Tennessee	$3,680,698	$5,521,047	$0	$9,201,746	2.0342	$18,718,191	193
Texas	$38,459,156	$57,688,734	$0	$96,147,891	1.8834	$181,084,937	1,863
Utah	$5,033,632	$7,550,448	$201,345	$12,785,425	1.8619	$23,805,183	245
Vermont	$1,249,536	$1,874,304	$77,971	$3,201,811	1.8578	$5,948,324	61
Virginia	$16,184,820	$24,277,230	$744,502	$41,206,552	1.8720	$77,138,665	793
Washington	$41,151,004	$61,726,505	$0	$102,877,509	2.1250	$218,614,707	2,249
West Virginia	$1,633,773	$2,450,659	$78,421	$4,162,853	1.8662	$7,768,716	80
Wisconsin	$3,067,760	$4,601,640	$159,524	$7,828,923	1.8642	$14,594,678	150
Wyoming	$169,117	$253,675	$0	$422,792	1.8583	$785,674	8
TOTAL	$456,000,000	$684,000,000	$13,370,225	$1,153,370,225		$2,276,186,016	23,413
Average						$45,523,720	468
STD						$66,842,438	688
MAX						$398,335,013	4,097
MIN						$785,674	8

Total Economic and Employment Impacts of Agriculture Direct Spending

Tables 11, 12 and 13 show the 2015 direct, indirect and induced impacts respectively, of agriculture spending. Table 11 presents the total economic and employment impacts of direct agriculture spending in all 50 states. The nationwide total economic impact is an estimated $1,058,841,630 with about 11,094 newly created jobs. The largest economic and employment impacts of direct agriculture spending is in California with total economic impact of more than $185,307,769 and creation of 1,942 new jobs. As before, the order of job creation was similar to overall economic impact. The state with least economic and employment impacts is Wyoming with $365,503 and four newly created jobs.

The average economic and employment impacts of direct agriculture spending per state are approximately $21,176,833 and an estimated 222 new jobs. The standard deviation of economic and employment impacts of direct agriculture spending is approximately $31,094,684 and new job creation of 326. This again reflects the wide spread of economic and employment impacts among states.

Total Economic and Employment Impacts of Agriculture Indirect Spending

The total economic and employment impact of indirect agriculture spending in all 50 states is shown in Table 12. The nationwide total economic impact is approximately $487,060,836, with an estimated 5,103 new jobs. The largest economic and employment impacts of indirect agriculture spending is in the state of California with a total economic impact of approximately $85,230,970 and creation of 893 new jobs. The order of job creation was similar to overall economic impact. Wyoming has the least economic and employment impact with $168,110 and creation of two new jobs.

The average economic and employment impacts of indirect agriculture spending per state are $9,741,217 and creation of 102 jobs. The standard deviation of economic and employment impacts of indirect agriculture spending is $14,302,673 and job creation of 150. The large standard deviation indicates the wide variability of economic and employment impacts among states.

Table 11: 2015 Direct Economic & Employment Impacts of Agriculture Spending

State	Direct Spending				State Direct Multipliers	Direct Economic Impact	Direct Employment Impact
	Payroll	Parts	Taxes	Total			
Alabama	$9,317,676	$13,976,514	$372,707	$23,666,897	0.9618	$22,762,822	238
Alaska	$611,763	$917,644	$0	$1,529,406	0.9405	$1,438,407	15
Arizona	$17,225,796	$25,838,695	$396,882	$43,461,373	1	$43,461,373	455
Arkansas	$2,565,690	$3,848,535	$143,679	$6,557,904	0.9453	$6,199,187	65
California	$65,438,414	$98,157,622	$2,094,029	$165,690,065	1.1184	$185,307,769	1942
Colorado	$7,416,208	$11,124,313	$274,696	$18,815,217	0.9542	$17,953,480	188
Connecticut	$16,575,698	$24,863,547	$663,028	$42,102,272	0.9898	$41,672,829	437
Delaware	$557,285	$835,928	$24,743	$1,417,956	0.9391	$1,331,602	14
Florida	$19,927,882	$29,891,823	$0	$49,819,705	0.9837	$49,007,644	513
Georgia	$11,882,156	$17,823,233	$570,343	$30,275,732	0.9705	$29,382,598	308
Hawaii	$1,041,126	$1,561,689	$59,969	$2,662,784	0.9396	$2,501,952	26
Idaho	$932,978	$1,399,467	$55,232	$2,387,678	0.9395	$2,243,223	24
Illinois	$6,571,201	$9,856,802	$262,848	$16,690,851	0.947	$15,806,236	166
Indiana	$6,686,613	$10,029,919	$181,876	$16,898,408	0.952	$16,087,285	169
Iowa	$5,193,121	$7,789,682	$141,253	$13,124,056	0.9388	$12,320,864	129
Kansas	$14,873,981	$22,310,972	$743,699	$37,928,652	0.9996	$37,913,480	397
Kentucky	$2,877,624	$4,316,437	$138,126	$7,332,187	0.9435	$6,917,918	72
Louisiana	$6,918,647	$10,377,970	$221,397	$17,518,014	0.9436	$16,529,998	173
Maine	$3,444,594	$5,166,891	$192,897	$8,804,383	0.9386	$8,263,794	87
Maryland	$10,645,314	$15,967,971	$404,522	$27,017,806	0.9627	$26,010,042	273
Massachusetts	$12,175,124	$18,262,685	$516,225	$30,954,034	0.9668	$29,926,360	314
Michigan	$6,060,323	$9,090,485	$210,899	$15,361,707	0.9468	$14,544,464	152
Minnesota	$4,561,989	$6,842,984	$257,296	$11,662,269	0.9433	$11,001,018	115
Mississippi	$5,268,583	$7,902,874	$168,595	$13,340,052	0.9405	$12,546,319	131
Missouri	$8,276,550	$12,414,825	$264,850	$20,956,224	0.9628	$20,176,653	211
Montana	$462,857	$694,286	$23,328	$1,180,471	0.9388	$1,108,226	12
Nebraska	$807,478	$1,211,217	$33,074	$2,051,770	0.9394	$1,927,432	20
Nevada	$1,255,001	$1,882,501	$0	$3,137,502	0.9427	$2,957,724	31
New Hampshire	$2,817,497	$4,226,246	$0	$7,043,743	0.94	$6,621,119	69
New Jersey	$8,353,625	$12,530,438	$497,876	$21,381,940	0.9537	$20,391,956	214
New Mexico	$3,271,880	$4,907,821	$112,553	$8,292,254	0.9415	$7,807,157	82
New York	$13,878,051	$20,817,077	$716,107	$35,411,235	0.9689	$34,309,946	359
North Carolina	$4,898,943	$7,348,414	$274,341	$12,521,698	0.945	$11,833,004	124
North Dakota	$453,576	$680,364	$10,233	$1,144,172	0.9386	$1,073,920	11
Ohio	$11,362,400	$17,043,599	$372,687	$28,778,686	0.9661	$27,803,088	291
Oklahoma	$3,410,294	$5,115,440	$143,232	$8,668,966	0.9471	$8,210,378	86
Oregon	$2,632,274	$3,948,411	$63,175	$6,643,859	0.9437	$6,269,810	66
Pennsylvania	$12,598,434	$18,897,651	$309,418	$31,805,503	0.9578	$30,463,311	319
Rhode Island	$1,364,360	$2,046,539	$58,326	$3,469,225	0.9413	$3,265,582	34
South Carolina	$3,185,523	$4,778,285	$178,389	$8,142,198	0.9386	$7,642,267	80
South Dakota	$305,881	$458,822	$0	$764,703	0.9431	$721,192	8
Tennessee	$3,390,117	$5,085,175	$0	$8,475,292	1.0274	$8,707,515	91
Texas	$35,422,907	$53,134,361	$0	$88,557,268	0.9512	$84,235,673	883
Utah	$4,636,240	$6,954,360	$185,450	$11,776,049	0.9403	$11,073,019	116
Vermont	$1,150,888	$1,726,333	$71,815	$2,949,036	0.9383	$2,767,081	29
Virginia	$14,907,071	$22,360,607	$685,725	$37,953,403	0.9455	$35,884,943	376
Washington	$37,902,240	$56,853,360	$0	$94,755,601	1.0732	$101,691,710	1065
West Virginia	$1,504,791	$2,257,186	$72,230	$3,834,206	0.9425	$3,613,739	38
Wisconsin	$2,825,568	$4,238,352	$146,930	$7,210,850	0.9415	$6,789,015	71
Wyoming	$155,765	$233,648	$0	$389,413	0.9386	$365,503	4
TOTAL	$420,000,000	$630,000,000	$12,314,681	$1,062,314,681		$1,058,841,630	11,094
Average						$21,176,833	222
STD						$31,094,684	326

Table 12: 2015 Indirect Economic & Employment Impacts of Agriculture Spending

State	Direct Spending				State Indirect Multipliers	Indirect Economic Impact	Indirect Employment Impact
	Payroll	Parts	Taxes	Total			
Alabama	$9,317,676	$13,976,514	$372,707	$23,666,897	0.4424	$10,470,235	110
Alaska	$611,763	$917,644	$0	$1,529,406	0.4327	$661,774	7
Arizona	$17,225,796	$25,838,695	$396,882	$43,461,373	0.46	$19,992,232	209
Arkansas	$2,565,690	$3,848,535	$143,679	$6,557,904	0.4349	$2,852,032	30
California	$65,438,414	$98,157,622	$2,094,029	$165,690,065	0.5144	$85,230,970	893
Colorado	$7,416,208	$11,124,313	$274,696	$18,815,217	0.4389	$8,257,999	87
Connecticut	$16,575,698	$24,863,547	$663,028	$42,102,272	0.4553	$19,169,165	201
Delaware	$557,285	$835,928	$24,743	$1,417,956	0.432	$612,557	6
Florida	$19,927,882	$29,891,823	$0	$49,819,705	0.4525	$22,543,417	236
Georgia	$11,882,156	$17,823,233	$570,343	$30,275,732	0.4464	$13,515,087	142
Hawaii	$1,041,126	$1,561,689	$59,969	$2,662,784	0.4322	$1,150,855	12
Idaho	$932,978	$1,399,467	$55,232	$2,387,678	0.4322	$1,031,954	11
Illinois	$6,571,201	$9,856,802	$262,848	$16,690,851	0.4356	$7,270,535	76
Indiana	$6,686,613	$10,029,919	$181,876	$16,898,408	0.4379	$7,399,813	78
Iowa	$5,193,121	$7,789,682	$141,253	$13,124,056	0.4319	$5,668,280	59
Kansas	$14,873,981	$22,310,972	$743,699	$37,928,652	0.4598	$17,439,594	183
Kentucky	$2,877,624	$4,316,437	$138,126	$7,332,187	0.434	$3,182,169	33
Louisiana	$6,918,647	$10,377,970	$221,397	$17,518,014	0.4341	$7,604,570	80
Maine	$3,444,594	$5,166,891	$192,897	$8,804,383	0.4317	$3,800,852	40
Maryland	$10,645,314	$15,967,971	$404,522	$27,017,806	0.4428	$11,963,485	125
Massachusetts	$12,175,124	$18,262,685	$516,225	$30,954,034	0.4447	$13,765,259	144
Michigan	$6,060,323	$9,090,485	$210,899	$15,361,707	0.4356	$6,691,560	70
Minnesota	$4,561,989	$6,842,984	$257,296	$11,662,269	0.4339	$5,060,258	53
Mississippi	$5,268,583	$7,902,874	$168,595	$13,340,052	0.4326	$5,770,906	60
Missouri	$8,276,550	$12,414,825	$264,850	$20,956,224	0.4429	$9,281,512	97
Montana	$462,857	$694,286	$23,328	$1,180,471	0.4319	$509,846	5
Nebraska	$807,478	$1,211,217	$33,074	$2,051,770	0.4321	$886,570	9
Nevada	$1,255,001	$1,882,501	$0	$3,137,502	0.4337	$1,360,735	14
New Hampshire	$2,817,497	$4,226,246	$0	$7,043,743	0.4324	$3,045,715	32
New Jersey	$8,353,625	$12,530,438	$497,876	$21,381,940	0.4387	$9,380,257	98
New Mexico	$3,271,880	$4,907,821	$112,553	$8,292,254	0.4331	$3,591,375	38
New York	$13,878,051	$20,817,077	$716,107	$35,411,235	0.4457	$15,782,787	165
North Carolina	$4,898,943	$7,348,414	$274,341	$12,521,698	0.4347	$5,443,182	57
North Dakota	$453,576	$680,364	$10,233	$1,144,172	0.4318	$494,054	5
Ohio	$11,362,400	$17,043,599	$372,687	$28,778,686	0.4444	$12,789,248	134
Oklahoma	$3,410,294	$5,115,440	$143,232	$8,668,966	0.4357	$3,777,069	40
Oregon	$2,632,274	$3,948,411	$63,175	$6,643,859	0.4341	$2,884,099	30
Pennsylvania	$12,598,434	$18,897,651	$309,418	$31,805,503	0.4406	$14,013,505	147
Rhode Island	$1,364,360	$2,046,539	$58,326	$3,469,225	0.433	$1,502,175	16
South Carolina	$3,185,523	$4,778,285	$178,389	$8,142,198	0.4318	$3,515,801	37
South Dakota	$305,881	$458,822	$0	$764,703	0.4338	$331,728	3
Tennessee	$3,390,117	$5,085,175	$0	$8,475,292	0.4726	$4,005,423	42
Texas	$35,422,907	$53,134,361	$0	$88,557,268	0.4376	$38,752,660	406
Utah	$4,636,240	$6,954,360	$185,450	$11,776,049	0.4326	$5,094,319	53
Vermont	$1,150,888	$1,726,333	$71,815	$2,949,036	0.4316	$1,272,804	13
Virginia	$14,907,071	$22,360,607	$685,725	$37,953,403	0.4349	$16,505,935	173
Washington	$37,902,240	$56,853,360	$0	$94,755,601	0.4937	$46,780,840	490
West Virginia	$1,504,791	$2,257,186	$72,230	$3,834,206	0.4336	$1,662,512	17
Wisconsin	$2,825,568	$4,238,352	$146,930	$7,210,850	0.4331	$3,123,019	33
Wyoming	$155,765	$233,648	$0	$389,413	0.4317	$168,110	2
TOTAL	$420,000,000	$630,000,000	$12,314,681	$1,062,314,681		$487,060,836	5,103
Average						$9,741,217	102
STD						$14,302,673	150

Total Economic and Employment Impacts of Agriculture Induced Spending

Table 13 presents the total economic and employment impacts of induced agriculture spending in 2015 in all 50 states. The estimated nationwide total economic impact is $550,584,654 with the creation of 5,770 new jobs. The largest economic and employment impacts of induced agriculture spending is in the state of California with a total economic impact of approximately $96,348,773 and creation of 1,010 new jobs. The order of job creation was similar to economic impact. The state of Wyoming has the least amount economic and employment impact with $190,034 and the creation of two new jobs. The average economic and employment impacts of induced agriculture spending per state are an estimated 11,011,693 and creation of 115 jobs. The standard deviation of economic and employment impacts of induced agriculture spending is approximately $16,168,047 and 169 jobs. There is wide variability in economic and employment impacts among states as is evidenced by the large standard deviation.

Table 13: 2015 Induced Economic & Employment Impacts of Agriculture Spending

State	Direct Spending				State Induced Multipliers	Induced Economic Impact	Induced Employment Impact
	Payroll	Parts	Taxes	Total			
Alabama	$9,317,676	$13,976,514	$372,707	$23,666,897	0.5001	$11,835,815	124
Alaska	$611,763	$917,644	$0	$1,529,406	0.4891	$748,033	8
Arizona	$17,225,796	$25,838,695	$396,882	$43,461,373	0.52	$22,599,914	237
Arkansas	$2,565,690	$3,848,535	$143,679	$6,557,904	0.4916	$3,223,866	34
California	$65,438,414	$98,157,622	$2,094,029	$165,690,065	0.5815	$96,348,773	1,010
Colorado	$7,416,208	$11,124,313	$274,696	$18,815,217	0.4962	$9,336,111	98
Connecticut	$16,575,698	$24,863,547	$663,028	$42,102,272	0.5147	$21,670,040	227
Delaware	$557,285	$835,928	$24,743	$1,417,956	0.4883	$692,388	7
Florida	$19,927,882	$29,891,823	$0	$49,819,705	0.5115	$25,482,779	267
Georgia	$11,882,156	$17,823,233	$570,343	$30,275,732	0.5047	$15,280,162	160
Hawaii	$1,041,126	$1,561,689	$59,969	$2,662,784	0.4886	$1,301,036	14
Idaho	$932,978	$1,399,467	$55,232	$2,387,678	0.4885	$1,166,381	12
Illinois	$6,571,201	$9,856,802	$262,848	$16,690,851	0.4924	$8,218,575	86
Indiana	$6,686,613	$10,029,919	$181,876	$16,898,408	0.4951	$8,366,402	88
Iowa	$5,193,121	$7,789,682	$141,253	$13,124,056	0.4882	$6,407,164	67
Kansas	$14,873,981	$22,310,972	$743,699	$37,928,652	0.5198	$19,715,313	207
Kentucky	$2,877,624	$4,316,437	$138,126	$7,332,187	0.4906	$3,597,171	38
Louisiana	$6,918,647	$10,377,970	$221,397	$17,518,014	0.4907	$8,596,089	90
Maine	$3,444,594	$5,166,891	$192,897	$8,804,383	0.4881	$4,297,419	45
Maryland	$10,645,314	$15,967,971	$404,522	$27,017,806	0.5006	$13,525,114	142
Massachusetts	$12,175,124	$18,262,685	$516,225	$30,954,034	0.5027	$15,560,593	163
Michigan	$6,060,323	$9,090,485	$210,899	$15,361,707	0.4924	$7,564,104	79
Minnesota	$4,561,989	$6,842,984	$257,296	$11,662,269	0.4905	$5,720,343	60
Mississippi	$5,268,583	$7,902,874	$168,595	$13,340,052	0.489	$6,523,285	68
Missouri	$8,276,550	$12,414,825	$264,850	$20,956,224	0.5007	$10,492,781	110
Montana	$462,857	$694,286	$23,328	$1,180,471	0.4882	$576,306	6
Nebraska	$807,478	$1,211,217	$33,074	$2,051,770	0.4885	$1,002,289	11
Nevada	$1,255,001	$1,882,501	$0	$3,137,502	0.4902	$1,538,004	16
New Hampshire	$2,817,497	$4,226,246	$0	$7,043,743	0.4888	$3,442,982	36
New Jersey	$8,353,625	$12,530,438	$497,876	$21,381,940	0.4959	$10,603,304	111
New Mexico	$3,271,880	$4,907,821	$112,553	$8,292,254	0.4896	$4,059,887	43
New York	$13,878,051	$20,817,077	$716,107	$35,411,235	0.5038	$17,840,180	187
North Carolina	$4,898,943	$7,348,414	$274,341	$12,521,698	0.4914	$6,153,162	64
North Dakota	$453,576	$680,364	$10,233	$1,144,172	0.4881	$558,471	6
Ohio	$11,362,400	$17,043,599	$372,687	$28,778,686	0.5024	$14,458,412	152
Oklahoma	$3,410,294	$5,115,440	$143,232	$8,668,966	0.4925	$4,269,466	45
Oregon	$2,632,274	$3,948,411	$63,175	$6,643,859	0.4907	$3,260,142	34
Pennsylvania	$12,598,434	$18,897,651	$309,418	$31,805,503	0.498	$15,839,141	166
Rhode Island	$1,364,360	$2,046,539	$58,326	$3,469,225	0.4895	$1,698,186	18
South Carolina	$3,185,523	$4,778,285	$178,389	$8,142,198	0.4881	$3,974,207	42
South Dakota	$305,881	$458,822	$0	$764,703	0.4904	$375,010	4
Tennessee	$3,390,117	$5,085,175	$0	$8,475,292	0.5342	$4,527,501	47
Texas	$35,422,907	$53,134,361	$0	$88,557,268	0.4946	$43,800,425	459
Utah	$4,636,240	$6,954,360	$185,450	$11,776,049	0.489	$5,758,488	60
Vermont	$1,150,888	$1,726,333	$71,815	$2,949,036	0.4879	$1,438,835	15
Virginia	$14,907,071	$22,360,607	$685,725	$37,953,403	0.4916	$18,657,893	196
Washington	$37,902,240	$56,853,360	$0	$94,755,601	0.5581	$52,883,101	554
West Virginia	$1,504,791	$2,257,186	$72,230	$3,834,206	0.4901	$1,879,145	20
Wisconsin	$2,825,568	$4,238,352	$146,930	$7,210,850	0.4896	$3,530,432	37
Wyoming	$155,765	$233,648	$0	$389,413	0.488	$190,034	2
TOTAL	$420,000,000	$630,000,000	$12,314,681	$1,062,314,681		$550,584,654	5,770
Average						$11,011,693	115
STD						$16,168,047	169

Total Economic and Employment Impacts of Public Safety and Other Direct Spending

Tables 14, 15, and 16 show the 2015 direct, indirect, and induced impacts respectively, of public safety spending. Since the impacts to "other" markets are equivalent to public safety, that data is not presented. Table 14 presents the total economic and employment impacts of direct public safety spending in all 50 states. The total economic impact is approximately $45,378,927 with a total job creation of 475. The largest economic and employment impacts of direct public safety spending is in the state of California with a total economic impact of $7,941,762 and creation of 83 new jobs. The state of Wyoming has the least economic and employment impacts among public safety direct spending with $15,664 and no new jobs created. The average economic and employment impacts of direct public safety spending per state are approximately $907,579 and creation of 10 new jobs. The standard deviation of economic and employment impacts of direct public safety spending are approximately $1,332,629 and new job creation of 14. The large standard deviation again indicates the variability of economic and employment impacts of direct public safety spending among states.

Total Economic and Employment Impacts of Public Safety and Other Indirect Spending

The total economic and employment impact of indirect public safety spending in 2015 in all 50 states is shown in Table 15. The nationwide total economic impact is approximately $20,874,036 creation of an estimated 219 new jobs. The largest economic and employment impacts of indirect public safety spending is in the state of California with total economic impact of more than $3,652,756 and creation of 38 new jobs. Wyoming has the least economic and employment impacts with $7,205 and no new jobs created.

The economic and employment impacts of indirect public safety spending per state averages approximately $417,481 and creation of four new jobs. The standard deviation of economic and employment impacts of indirect public safety spending are $612,972 creation of six new jobs. As with public safety direct spending, there is a wide variability of economic and employment impacts among the states.

Table 14: 2015 Direct Economic & Employment Impacts of Public Safety Spending

State	Direct Spending				State Direct Multipliers	Direct Economic Impact	Direct Employment Impact
	Payroll	Parts	Taxes	Total			
Alabama	$399,329	$598,993	$15,973	$1,014,296	0.9618	$975,550	10
Alaska	$26,218	$39,328	$0	$65,546	0.9405	$61,646	1
Arizona	$738,248	$1,107,373	$17,009	$1,862,630	1	$1,862,630	20
Arkansas	$109,958	$164,937	$6,158	$281,053	0.9453	$265,679	3
California	$2,804,503	$4,206,755	$89,744	$7,101,003	1.1184	$7,941,762	83
Colorado	$317,838	$476,756	$11,773	$806,366	0.9542	$769,435	8
Connecticut	$710,387	$1,065,581	$28,415	$1,804,383	0.9898	$1,785,978	19
Delaware	$23,884	$35,825	$1,060	$60,770	0.9391	$57,069	1
Florida	$854,052	$1,281,078	$0	$2,135,130	0.9837	$2,100,328	22
Georgia	$509,235	$763,853	$24,443	$1,297,531	0.9705	$1,259,254	13
Hawaii	$44,620	$66,930	$2,570	$114,119	0.9396	$107,227	1
Idaho	$39,985	$59,977	$2,367	$102,329	0.9395	$96,138	1
Illinois	$281,623	$422,434	$11,265	$715,322	0.947	$677,410	7
Indiana	$286,569	$429,854	$7,795	$724,217	0.952	$689,455	7
Iowa	$222,562	$333,844	$6,054	$562,460	0.9388	$528,037	6
Kansas	$637,456	$956,184	$31,873	$1,625,514	0.9996	$1,624,863	17
Kentucky	$123,327	$184,990	$5,920	$314,237	0.9435	$296,482	3
Louisiana	$296,513	$444,770	$9,488	$750,772	0.9436	$708,428	7
Maine	$147,625	$221,438	$8,267	$377,331	0.9386	$354,163	4
Maryland	$456,228	$684,342	$17,337	$1,157,906	0.9627	$1,114,716	12
Massachusetts	$521,791	$782,687	$22,124	$1,326,601	0.9668	$1,282,558	13
Michigan	$259,728	$389,592	$9,039	$658,359	0.9468	$623,334	7
Minnesota	$195,514	$293,271	$11,027	$499,812	0.9433	$471,472	5
Mississippi	$225,796	$338,695	$7,225	$571,717	0.9405	$537,699	6
Missouri	$354,709	$532,064	$11,351	$898,124	0.9628	$864,714	9
Montana	$19,837	$29,755	$1,000	$50,592	0.9388	$47,495	0
Nebraska	$34,606	$51,909	$1,417	$87,933	0.9394	$82,604	1
Nevada	$53,786	$80,679	$0	$134,464	0.9427	$126,760	1
New Hampshire	$120,750	$181,125	$0	$301,875	0.94	$283,762	3
New Jersey	$358,013	$537,019	$21,338	$916,369	0.9537	$873,941	9
New Mexico	$140,223	$210,335	$4,824	$355,382	0.9415	$334,592	4
New York	$594,774	$892,160	$30,690	$1,517,624	0.9689	$1,470,426	15
North Carolina	$209,955	$314,932	$11,757	$536,644	0.945	$507,129	5
North Dakota	$19,439	$29,158	$439	$49,036	0.9386	$46,025	0
Ohio	$486,960	$730,440	$15,972	$1,233,372	0.9661	$1,191,561	12
Oklahoma	$146,155	$219,233	$6,139	$371,527	0.9471	$351,873	4
Oregon	$112,812	$169,218	$2,707	$284,737	0.9437	$268,706	3
Pennsylvania	$539,933	$809,899	$13,261	$1,363,093	0.9578	$1,305,570	14
Rhode Island	$58,473	$87,709	$2,500	$148,681	0.9413	$139,954	1
South Carolina	$136,522	$204,784	$7,645	$348,951	0.9386	$327,526	3
South Dakota	$13,109	$19,664	$0	$32,773	0.9431	$30,908	0
Tennessee	$145,291	$217,936	$0	$363,227	1.0274	$373,179	4
Texas	$1,518,125	$2,277,187	$0	$3,795,311	0.9512	$3,610,100	38
Utah	$198,696	$298,044	$7,948	$504,688	0.9403	$474,558	5
Vermont	$49,324	$73,986	$3,078	$126,387	0.9383	$118,589	1
Virginia	$638,874	$958,312	$29,388	$1,626,574	0.9455	$1,537,926	16
Washington	$1,624,382	$2,436,573	$0	$4,060,954	1.0732	$4,358,216	46
West Virginia	$64,491	$96,737	$3,096	$164,323	0.9425	$154,875	2
Wisconsin	$121,096	$181,644	$6,297	$309,036	0.9415	$290,958	3
Wyoming	$6,676	$10,013	$0	$16,689	0.9386	$15,664	0
TOTAL	$18,000,000	$27,000,000	$527,772	$45,527,772		$45,378,927	475
Average						$907,579	10
STD						$1,332,629	14
MAX						$7,941,762	83
MIN						$15,664	0

Table 15: 2015 Indirect Economic & Employment Impacts of Public Safety Spending

State	Direct Spending				State Indirect Multipliers	Indirect Economic Impact	Indirect Employment Impact
	Payroll	Parts	Taxes	Total			
Alabama	$399,329	$598,993	$15,973	$1,014,296	0.4424	$448,724	5
Alaska	$26,218	$39,328	$0	$65,546	0.4327	$28,362	0
Arizona	$738,248	$1,107,373	$17,009	$1,862,630	0.46	$856,810	9
Arkansas	$109,958	$164,937	$6,158	$281,053	0.4349	$122,230	1
California	$2,804,503	$4,206,755	$89,744	$7,101,003	0.5144	$3,652,756	38
Colorado	$317,838	$476,756	$11,773	$806,366	0.4389	$353,914	4
Connecticut	$710,387	$1,065,581	$28,415	$1,804,383	0.4553	$821,536	9
Delaware	$23,884	$35,825	$1,060	$60,770	0.432	$26,252	0
Florida	$854,052	$1,281,078	$0	$2,135,130	0.4525	$966,146	10
Georgia	$509,235	$763,853	$24,443	$1,297,531	0.4464	$579,218	6
Hawaii	$44,620	$66,930	$2,570	$114,119	0.4322	$49,322	1
Idaho	$39,985	$59,977	$2,367	$102,329	0.4322	$44,227	0
Illinois	$281,623	$422,434	$11,265	$715,322	0.4356	$311,594	3
Indiana	$286,569	$429,854	$7,795	$724,217	0.4379	$317,135	3
Iowa	$222,562	$333,844	$6,054	$562,460	0.4319	$242,926	3
Kansas	$637,456	$956,184	$31,873	$1,625,514	0.4598	$747,411	8
Kentucky	$123,327	$184,990	$5,920	$314,237	0.434	$136,379	1
Louisiana	$296,513	$444,770	$9,488	$750,772	0.4341	$325,910	3
Maine	$147,625	$221,438	$8,267	$377,331	0.4317	$162,894	2
Maryland	$456,228	$684,342	$17,337	$1,157,906	0.4428	$512,721	5
Massachusetts	$521,791	$782,687	$22,124	$1,326,601	0.4447	$589,940	6
Michigan	$259,728	$389,592	$9,039	$658,359	0.4356	$286,781	3
Minnesota	$195,514	$293,271	$11,027	$499,812	0.4339	$216,868	2
Mississippi	$225,796	$338,695	$7,225	$571,717	0.4326	$247,325	3
Missouri	$354,709	$532,064	$11,351	$898,124	0.4429	$397,779	4
Montana	$19,837	$29,755	$1,000	$50,592	0.4319	$21,851	0
Nebraska	$34,606	$51,909	$1,417	$87,933	0.4321	$37,996	0
Nevada	$53,786	$80,679	$0	$134,464	0.4337	$58,317	1
New Hampshire	$120,750	$181,125	$0	$301,875	0.4324	$130,531	1
New Jersey	$358,013	$537,019	$21,338	$916,369	0.4387	$402,011	4
New Mexico	$140,223	$210,335	$4,824	$355,382	0.4331	$153,916	2
New York	$594,774	$892,160	$30,690	$1,517,624	0.4457	$676,405	7
North Carolina	$209,955	$314,932	$11,757	$536,644	0.4347	$233,279	2
North Dakota	$19,439	$29,158	$439	$49,036	0.4318	$21,174	0
Ohio	$486,960	$730,440	$15,972	$1,233,372	0.4444	$548,111	6
Oklahoma	$146,155	$219,233	$6,139	$371,527	0.4357	$161,874	2
Oregon	$112,812	$169,218	$2,707	$284,737	0.4341	$123,604	1
Pennsylvania	$539,933	$809,899	$13,261	$1,363,093	0.4406	$600,579	6
Rhode Island	$58,473	$87,709	$2,500	$148,681	0.433	$64,379	1
South Carolina	$136,522	$204,784	$7,645	$348,951	0.4318	$150,677	2
South Dakota	$13,109	$19,664	$0	$32,773	0.4338	$14,217	0
Tennessee	$145,291	$217,936	$0	$363,227	0.4726	$171,661	2
Texas	$1,518,125	$2,277,187	$0	$3,795,311	0.4376	$1,660,828	17
Utah	$198,696	$298,044	$7,948	$504,688	0.4326	$218,328	2
Vermont	$49,324	$73,986	$3,078	$126,387	0.4316	$54,549	1
Virginia	$638,874	$958,312	$29,388	$1,626,574	0.4349	$707,397	7
Washington	$1,624,382	$2,436,573	$0	$4,060,954	0.4937	$2,004,893	21
West Virginia	$64,491	$96,737	$3,096	$164,323	0.4336	$71,251	1
Wisconsin	$121,096	$181,644	$6,297	$309,036	0.4331	$133,844	1
Wyoming	$6,676	$10,013	$0	$16,689	0.4317	$7,205	0
TOTAL	$18,000,000	$27,000,000	$527,772	$45,527,772		$20,874,036	219
Average						$417,481	4
STD						$612,972	6
MAX						$3,652,756	38
MIN						$7,205	0

Total Economic and Employment Impacts of Public Safety and Other Induced Spending

Table 16 presents the total economic and employment impacts of induced public safety spending in 2015 in all 50 states. The total economic impact is estimated to be $23,596,485 with total new job creation of 247. The largest economic and employment impacts of induced public safety spending is in the state of California with a total economic impact of approximately $4,129,233 and creation of 43 new jobs. Following California are the states of Washington, Texas, Florida and Arizona. The order of job creation was similar to economic impact. The state with least economic and employment impacts is Wyoming with $8,144 and no new jobs created.

The average economic and employment impacts of induced public safety spending per state are an estimated $471,930 and creation of five jobs. The standard deviation of economic and employment impacts of induced public safety spending are approximately $692,916 and creation of seven new jobs. The large standard deviation indicates the wide variability of economic and employment impacts among states.

Table 16: 2015 Induced Economic & Employment Impacts of Public Safety Spending

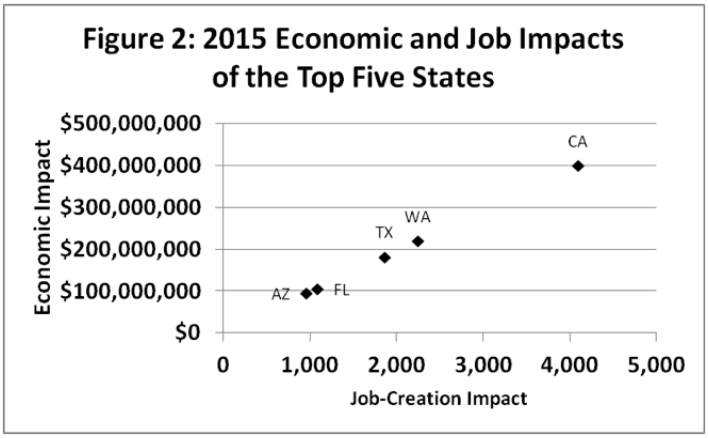
State	Direct Spending				State Induced Multipliers	Induced Economic Impact	Induced Employment Impact
	Payroll	Parts	Taxes	Total			
Alabama	$399,329	$598,993	$15,973	$1,014,296	0.5001	$507,249	5
Alaska	$26,218	$39,328	$0	$65,546	0.4891	$32,059	0
Arizona	$738,248	$1,107,373	$17,009	$1,862,630	0.52	$968,568	10
Arkansas	$109,958	$164,937	$6,158	$281,053	0.4916	$138,166	1
California	$2,804,503	$4,206,755	$89,744	$7,101,003	0.5815	$4,129,233	43
Colorado	$317,838	$476,756	$11,773	$806,366	0.4962	$400,119	4
Connecticut	$710,387	$1,065,581	$28,415	$1,804,383	0.5147	$928,716	10
Delaware	$23,884	$35,825	$1,060	$60,770	0.4883	$29,674	0
Florida	$854,052	$1,281,078	$0	$2,135,130	0.5115	$1,092,119	11
Georgia	$509,235	$763,853	$24,443	$1,297,531	0.5047	$654,864	7
Hawaii	$44,620	$66,930	$2,570	$114,119	0.4886	$55,759	1
Idaho	$39,985	$59,977	$2,367	$102,329	0.4885	$49,988	1
Illinois	$281,623	$422,434	$11,265	$715,322	0.4924	$352,225	4
Indiana	$286,569	$429,854	$7,795	$724,217	0.4951	$358,560	4
Iowa	$222,562	$333,844	$6,054	$562,460	0.4882	$274,593	3
Kansas	$637,456	$956,184	$31,873	$1,625,514	0.5198	$844,942	9
Kentucky	$123,327	$184,990	$5,920	$314,237	0.4906	$154,164	2
Louisiana	$296,513	$444,770	$9,488	$750,772	0.4907	$368,404	4
Maine	$147,625	$221,438	$8,267	$377,331	0.4881	$184,175	2
Maryland	$456,228	$684,342	$17,337	$1,157,906	0.5006	$579,648	6
Massachusetts	$521,791	$782,687	$22,124	$1,326,601	0.5027	$666,883	7
Michigan	$259,728	$389,592	$9,039	$658,359	0.4924	$324,176	3
Minnesota	$195,514	$293,271	$11,027	$499,812	0.4905	$245,158	3
Mississippi	$225,796	$338,695	$7,225	$571,717	0.489	$279,569	3
Missouri	$354,709	$532,064	$11,351	$898,124	0.5007	$449,691	5
Montana	$19,837	$29,755	$1,000	$50,592	0.4882	$24,699	0
Nebraska	$34,606	$51,909	$1,417	$87,933	0.4885	$42,955	0
Nevada	$53,786	$80,679	$0	$134,464	0.4902	$65,914	1
New Hampshire	$120,750	$181,125	$0	$301,875	0.4888	$147,556	2
New Jersey	$358,013	$537,019	$21,338	$916,369	0.4959	$454,427	5
New Mexico	$140,223	$210,335	$4,824	$355,382	0.4896	$173,995	2
New York	$594,774	$892,160	$30,690	$1,517,624	0.5038	$764,579	8
North Carolina	$209,955	$314,932	$11,757	$536,644	0.4914	$263,707	3
North Dakota	$19,439	$29,158	$439	$49,036	0.4881	$23,934	0
Ohio	$486,960	$730,440	$15,972	$1,233,372	0.5024	$619,646	6
Oklahoma	$146,155	$219,233	$6,139	$371,527	0.4925	$182,977	2
Oregon	$112,812	$169,218	$2,707	$284,737	0.4907	$139,720	1
Pennsylvania	$539,933	$809,899	$13,261	$1,363,093	0.498	$678,820	7
Rhode Island	$58,473	$87,709	$2,500	$148,681	0.4895	$72,779	1
South Carolina	$136,522	$204,784	$7,645	$348,951	0.4881	$170,323	2
South Dakota	$13,109	$19,664	$0	$32,773	0.4904	$16,072	0
Tennessee	$145,291	$217,936	$0	$363,227	0.5342	$194,036	2
Texas	$1,518,125	$2,277,187	$0	$3,795,311	0.4946	$1,877,161	20
Utah	$198,696	$298,044	$7,948	$504,688	0.489	$246,792	3
Vermont	$49,324	$73,986	$3,078	$126,387	0.4879	$61,664	1
Virginia	$638,874	$958,312	$29,388	$1,626,574	0.4916	$799,624	8
Washington	$1,624,382	$2,436,573	$0	$4,060,954	0.5581	$2,266,419	24
West Virginia	$64,491	$96,737	$3,096	$164,323	0.4901	$80,535	1
Wisconsin	$121,096	$181,644	$6,297	$309,036	0.4896	$151,304	2
Wyoming	$6,676	$10,013	$0	$16,689	0.488	$8,144	0
TOTAL	$18,000,000	$27,000,000	$527,772	$45,527,772		$23,596,485	247
Average						$471,930	5
STD						$692,916	7
MAX						$4,129,233	43
MIN						$8,144	0

Total Economic and Employment Impacts of UAS Development in the Top Five States

A comparison of the total economic and job creation impacts of UAS integration in the U.S. in the top five states is presented in Table 17. The orders of output and job multipliers are consistent with the order of the states in terms of direct spending. California is the number one state with the highest direct spending of $179,892,071 and the highest direct employment of 2,108, which resulted in the highest contribution to total economic impact of approximately $398,335,013 and total new job creation impact of approximately 4,097. In addition, California has the highest multipliers for job and output creation. Figure 2 graphically shows the total economic and job creation impacts of the top five states in the U.S.

Table 17: 2015 Total Economic and Employment Impacts of UAS Development in the Top Five States

State	Direct jobs	Total job Creation Impact	Job multiplier	Direct spending	Total Economic impact	Output multiplier
California	2108	4,097	1.94	179,892,071	398,335,013	2.21
Washington	1157	2,249	1.94	102,877,509	218,614,707	2.13
Texas	958	1,863	1.94	96,147,891	181,084,937	1.88
Florida	557	1,084	1.94	54,089,966	105,351,026	1.95
Arizona	494	961	1.94	47,186,634	93,429,535	1.98



Total Economic and Employment Impacts of UAS Development in the United States From 2015-2025

UAS integration into the NAS will have tremendous economic and job creation impacts on the aerospace industry and aid in driving economic development in many states across the country. In today's economic environment, job creation will continue to be extremely important for the aerospace industry and the U.S. economy. Note that the economic impact of UAS integration will not stop with the primary UAS market. Similar to other industries, job growth will stretch into many additional sectors, and the economic growth in the aerospace industry will support the growth in many other businesses across multiple U.S. industries, including the hospitality and entertainment industries.

The total direct spending in UAS development and the total economic and employment impacts are expected to increase significantly in the next 11 years from 2015 through 2025, as seen in Table 18. The expected total direct spending in UAS development in 2015 is an estimated $1,153,370,225. This amount is expected to increase by 100% in 2016 to approximately $2,306,740,450. In 2017, total direct spending is expected to increase by 50% to an estimated $3,460,110,675. This rate of growth is expected to decrease in 2018 to approximately 5% with total spending of $3,633,116,209 and to level off at 5% between 2019 and 2025, with total spending in 2025 of 5,112,159,353.

Table 18: Direct Spending and Employment in The U.S. from 2015-2025

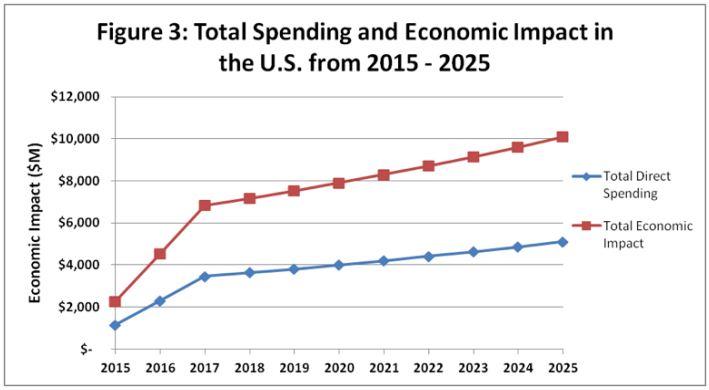
Year	Total Direct Spending	Total Direct Employment	Percent Change Over Previous Year
2015	$ 1,153,370,225	11,400	
2016	$ 2,306,740,450	22,800	100%
2017	$ 3,460,110,675	34,200	50%
2018	$ 3,633,116,209	35,910	5%
2019	$ 3,814,772,019	37,706	5%
2020	$ 4,005,510,620	39,591	5%
2021	$ 4,205,786,151	41,570	5%
2022	$ 4,416,075,459	43,649	5%
2023	$ 4,636,879,232	45,831	5%
2024	$ 4,868,723,193	48,123	5%
2025	$ 5,112,159,353	50,529	5%

The expected total economic and employment impacts in the U.S. for UAS integration for the 11-year period from 2015 through 2025 is shown in Table 19. In 2015, the expected total economic and employment impacts are estimated to be $2,276,186,016 with creation of 23,413 jobs. These amounts are expected to increase by 100% in 2016 (from 2015) to approximately $4,552,372,033 in economic impact and job creation of 46,826. In 2017, the economic and employment impacts are expected to increase by approximately 50% to $6,828,558,049 and 70,240 jobs. This rate of growth is expected to decrease in 2018 to approximately 5% and level off at 5% through 2025. By 2025, the expected total economic impact is estimated to be $10,088,890,263 and total employment impact 103,776.

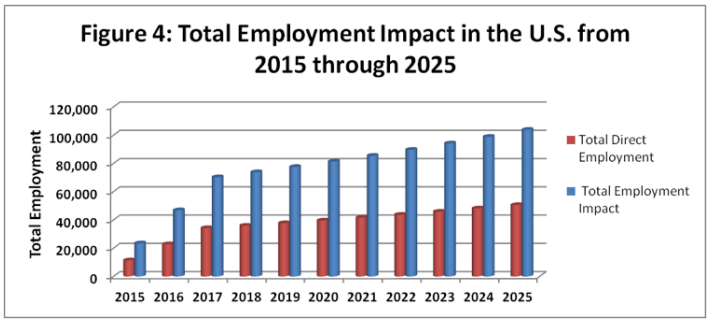
Table 19: Economic & Employment Impacts in The U.S. from 2015-2025

Year	Total Direct Spending	Total Economic Impact	Total Employment Impact	Percent Change Over Previous Year
2015	$1,153,370,225	$ 2,276,186,016	23,413	
2016	$2,306,740,450	$ 4,552,372,033	46,826	100%
2017	$3,460,110,675	$ 6,828,558,049	70,240	50%
2018	$3,633,116,209	$ 7,169,985,952	73,752	5%
2019	$3,814,772,019	$ 7,528,485,249	77,439	5%
2020	$4,005,510,620	$ 7,904,909,512	81,311	5%
2021	$4,205,786,151	$ 8,300,154,987	85,377	5%
2022	$4,416,075,459	$ 8,715,162,737	89,645	5%
2023	$4,636,879,232	$ 9,150,920,874	94,128	5%
2024	$4,868,723,193	$ 9,608,466,917	98,834	5%
2025	$5,112,159,353	$10,088,890,263	103,776	5%

Figure 3 graphically compares total spending and economic impacts from 2015 to 2025. There are high growth rates for both spending and total economic impact in the first three years (2015-2017) but both spending and total economic impact growth are expected to decrease to 5% in 2018 and level off at 5% through 2025.



Direct employment and total employment impact from 2015 to 2025 are compared in Figure 4. There are high growth rates for both direct and total employment impacts in the first three years (2015-2017) to approximately 100% and 50% in 2016 and 2017, respectively. The growth rate of both direct employment and total employment impacts are expected to decrease to 5% in 2018 and level off at 5% through 2025.



Conclusion

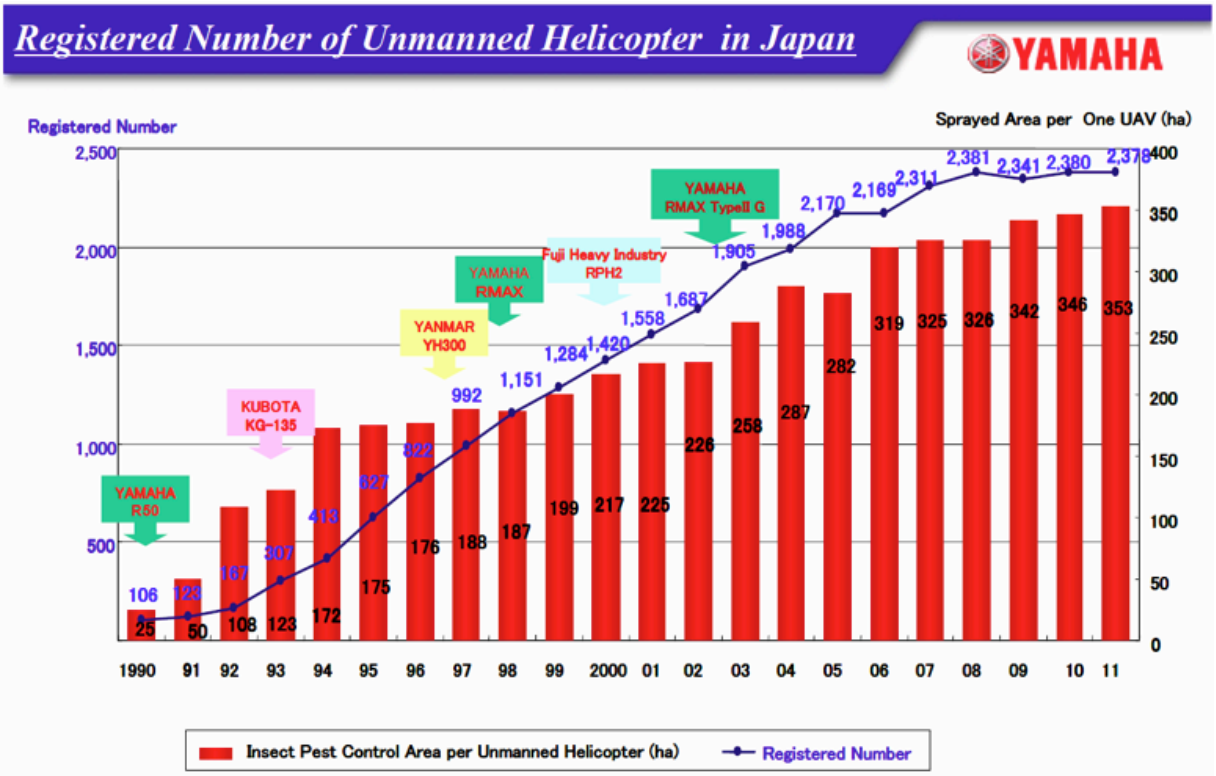
UAS integration into the NAS is expected to have enormous economic and job creation impacts in the United States. These impacts have been demonstrated to be due to direct, indirect and induced effects of total spending in UAS development. The results of these economic impacts are as follows:

During the 11-year period 2015-2025:

- UAS integration is expected to contribute $82.1 billion to the nation's economy by agriculture, public safety and other activities;
- 103,776 new jobs will be created, with 844,741 job years worked over the time period;
- UAS integration is expected to contribute $75.6 billion economic impact by agriculture, $3.2 billion by public safety and $3.2 billion by other activities;
- The manufacturing jobs created will be high paying ($40,000) and require technical baccalaureate degrees; and
- In the first three years, U.S. airspace integration will create more than 34,000 manufacturing jobs and more than 70,000 new jobs.

This study demonstrates the significant contribution of UAS integration to the economic growth and job creation in the aerospace industry and to the social and economic progress of the citizens in the United States.

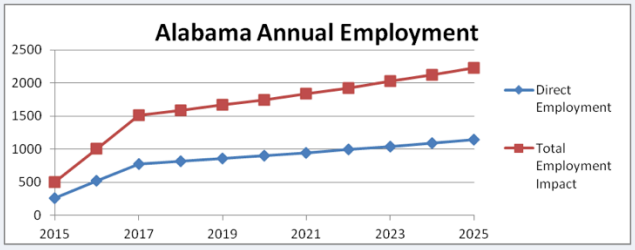
Appendix A

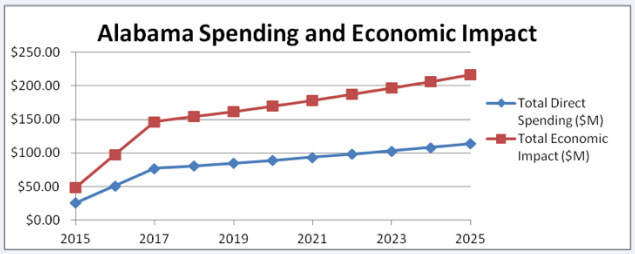


Sato, Akira (2011, October). Civil UAV Applications in Japan and Related Safety & Certification. Presented at the 1st Annual Agricultural UAS Conference: Precision Agriculture, Atlanta, GA.

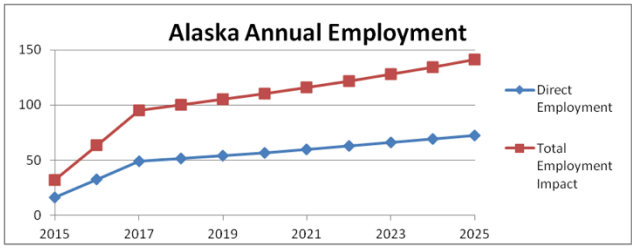
Appendix B
State Level Detailed Economic Impact

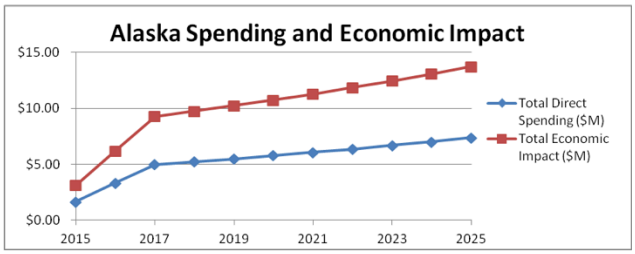
Alabama Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	259	503	$25.70	$48.93	$404.65	
2016	518	1007	$51.39	$97.86	$809.31	100%
2017	777	1510	$77.09	$146.80	$1,213.96	50%
2018	816	1585	$80.94	$154.14	$1,274.66	5%
2019	856	1665	$84.99	$161.84	$1,338.39	5%
2020	899	1748	$89.24	$169.93	$1,405.31	5%
2021	944	1835	$93.70	$178.43	$1,475.58	5%
2022	991	1927	$98.38	$187.35	$1,549.35	5%
2023	1041	2023	$103.30	$196.72	$1,626.82	5%
2024	1093	2125	$108.47	$206.56	$1,708.16	5%
2025	1148	2231	$113.89	$216.88	$1,793.57	5%



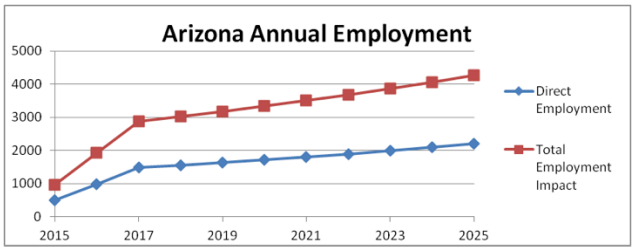


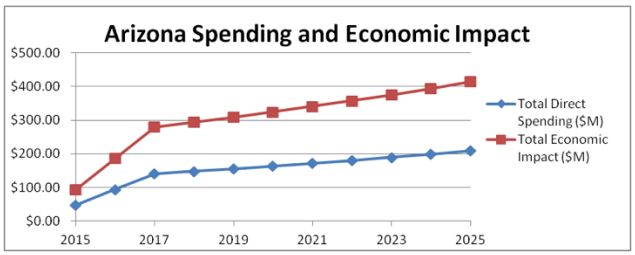
Alaska Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	16	32	$1.66	$3.09	$0.00	
2016	33	64	$3.32	$6.18	$0.00	100%
2017	49	95	$4.98	$9.28	$0.00	50%
2018	52	100	$5.23	$9.74	$0.00	5%
2019	54	105	$5.49	$10.23	$0.00	5%
2020	57	110	$5.77	$10.74	$0.00	5%
2021	60	116	$6.06	$11.28	$0.00	5%
2022	63	122	$6.36	$11.84	$0.00	5%
2023	66	128	$6.68	$12.43	$0.00	5%
2024	69	134	$7.01	$13.05	$0.00	5%
2025	73	141	$7.36	$13.71	$0.00	5%



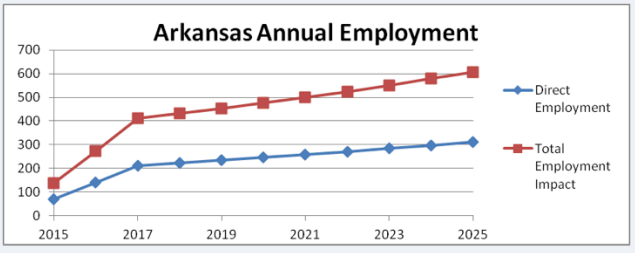


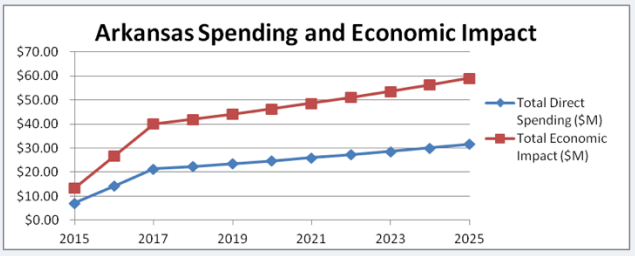
Arizona Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	494	961	$47.19	$93.43	$430.90	
2016	989	1922	$94.37	$186.86	$861.80	100%
2017	1483	2883	$141.56	$280.29	$1,292.70	50%
2018	1557	3027	$148.64	$294.30	$1,357.34	5%
2019	1635	3179	$156.07	$309.02	$1,425.20	5%
2020	1717	3338	$163.87	$324.47	$1,496.46	5%
2021	1803	3504	$172.07	$340.69	$1,571.29	5%
2022	1893	3680	$180.67	$357.73	$1,649.85	5%
2023	1988	3864	$189.70	$375.61	$1,732.34	5%
2024	2087	4057	$199.19	$394.39	$1,818.96	5%
2025	2191	4260	$209.15	$414.11	$1,909.91	5%



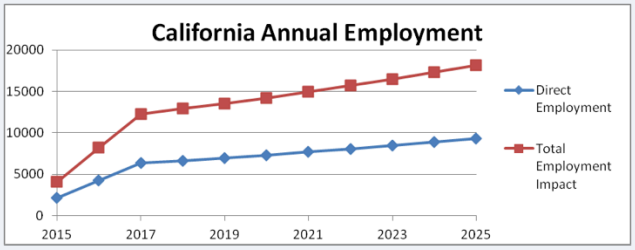


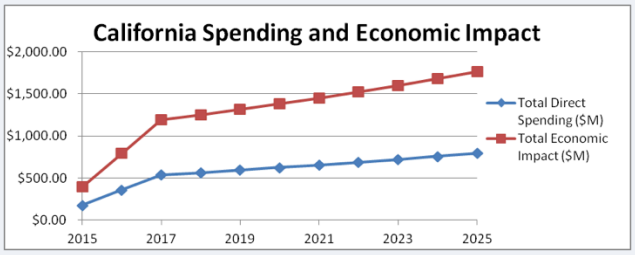
Arkansas Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	71	137	$7.12	$13.33	$155.99	
2016	141	274	$14.24	$26.65	$311.99	100%
2017	212	411	$21.36	$39.98	$467.98	50%
2018	222	432	$22.43	$41.98	$491.38	5%
2019	233	453	$23.55	$44.08	$515.95	5%
2020	245	476	$24.73	$46.28	$541.75	5%
2021	257	500	$25.96	$48.60	$568.83	5%
2022	270	525	$27.26	$51.03	$597.28	5%
2023	284	551	$28.62	$53.58	$627.14	5%
2024	298	579	$30.06	$56.26	$658.50	5%
2025	313	608	$31.56	$59.07	$691.42	5%



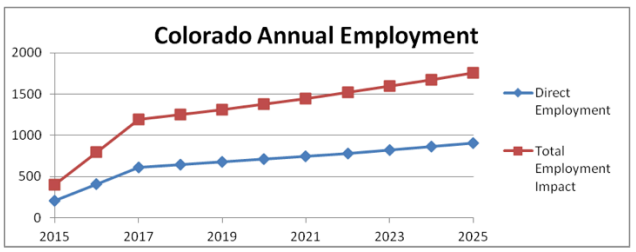


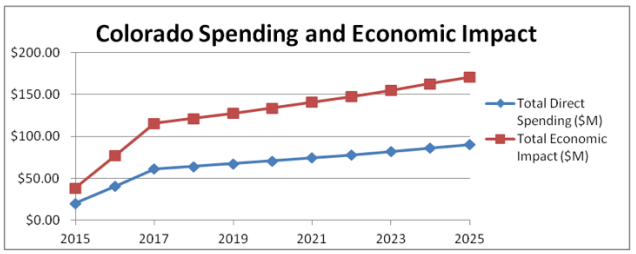
California Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	2108	4097	$179.89	$398.34	$2,273.52	
2016	4216	8195	$359.78	$796.67	$4,547.03	100%
2017	6324	12292	$539.68	$1,195.01	$6,820.55	50%
2018	6640	12907	$566.66	$1,254.76	$7,161.58	5%
2019	6972	13552	$594.99	$1,317.49	$7,519.66	5%
2020	7321	14230	$624.74	$1,383.37	$7,895.64	5%
2021	7687	14941	$655.98	$1,452.54	$8,290.42	5%
2022	8071	15688	$688.78	$1,525.16	$8,704.95	5%
2023	8475	16472	$723.22	$1,601.42	$9,140.19	5%
2024	8898	17296	$759.38	$1,681.49	$9,597.20	5%
2025	9343	18161	$797.35	$1,765.57	$10,077.06	5%



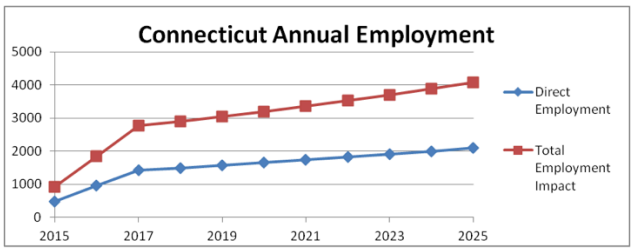


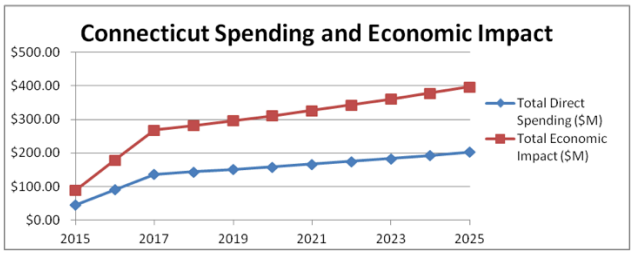
Colorado Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	204	397	$20.43	$38.59	$298.24	
2016	408	794	$40.86	$77.19	$596.48	100%
2017	613	1191	$61.28	$115.78	$894.73	50%
2018	643	1251	$64.35	$121.57	$939.46	5%
2019	675	1313	$67.57	$127.65	$986.43	5%
2020	709	1379	$70.94	$134.03	$1,035.76	5%
2021	745	1448	$74.49	$140.74	$1,087.54	5%
2022	782	1520	$78.22	$147.77	$1,141.92	5%
2023	821	1596	$82.13	$155.16	$1,199.02	5%
2024	862	1676	$86.23	$162.92	$1,258.97	5%
2025	905	1760	$90.54	$171.07	$1,321.92	5%



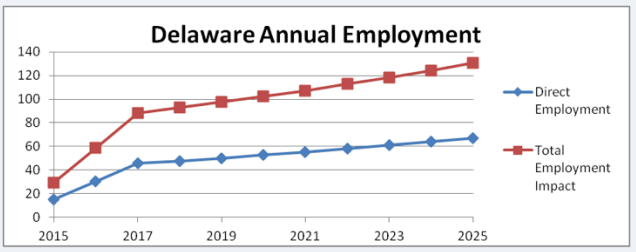


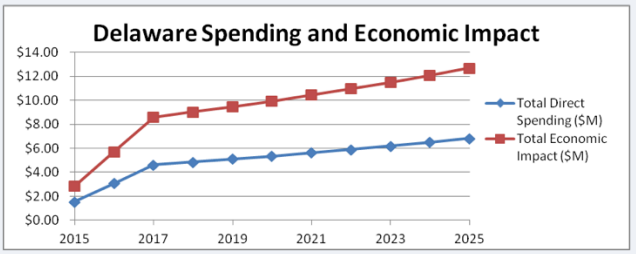
Connecticut Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	474	921	$45.71	$89.58	$719.86	
2016	948	1843	$91.42	$179.17	$1,439.72	100%
2017	1422	2764	$137.13	$268.75	$2,159.58	50%
2018	1493	2903	$143.99	$282.19	$2,267.56	5%
2019	1568	3048	$151.19	$296.30	$2,380.93	5%
2020	1646	3200	$158.75	$311.12	$2,499.98	5%
2021	1729	3360	$166.69	$326.67	$2,624.98	5%
2022	1815	3528	$175.02	$343.01	$2,756.23	5%
2023	1906	3705	$183.77	$360.16	$2,894.04	5%
2024	2001	3890	$192.96	$378.16	$3,038.74	5%
2025	2101	4084	$202.61	$397.07	$3,190.68	5%



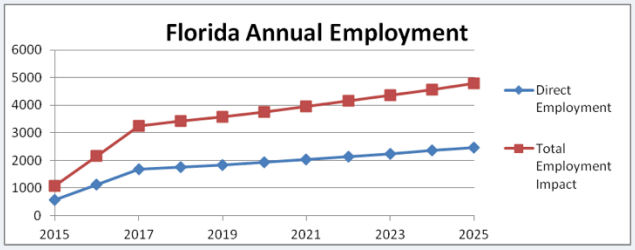


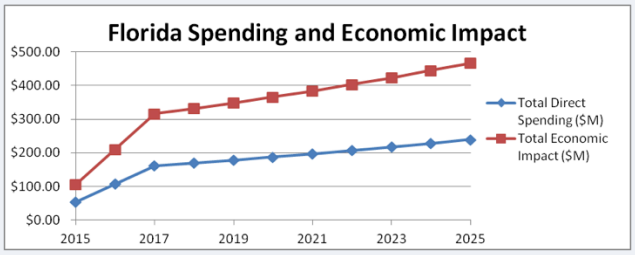
Delaware Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	15	29	$1.54	$2.86	$26.86	
2016	30	59	$3.08	$5.73	$53.73	100%
2017	45	88	$4.62	$8.59	$80.59	50%
2018	48	93	$4.85	$9.02	$84.62	5%
2019	50	97	$5.09	$9.47	$88.85	5%
2020	53	102	$5.35	$9.94	$93.30	5%
2021	55	107	$5.61	$10.44	$97.96	5%
2022	58	113	$5.89	$10.96	$102.86	5%
2023	61	118	$6.19	$11.51	$108.00	5%
2024	64	124	$6.50	$12.08	$113.40	5%
2025	67	131	$6.82	$12.69	$119.07	5%



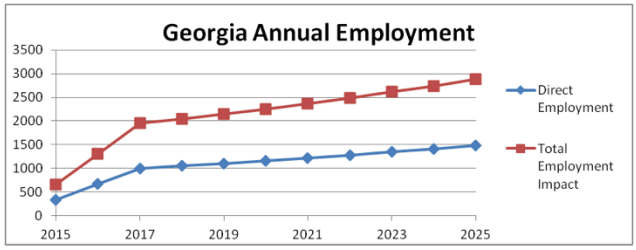


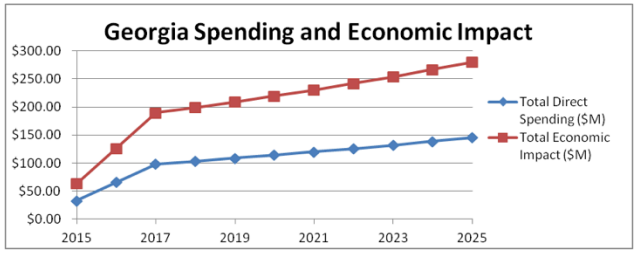
Florida Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	557	1084	$54.09	$105.35	$0.00	
2016	1115	2167	$108.18	$210.70	$0.00	100%
2017	1672	3251	$162.27	$316.05	$0.00	50%
2018	1756	3414	$170.38	$331.86	$0.00	5%
2019	1844	3584	$178.90	$348.45	$0.00	5%
2020	1936	3763	$187.85	$365.87	$0.00	5%
2021	2033	3952	$197.24	$384.16	$0.00	5%
2022	2135	4149	$207.10	$403.37	$0.00	5%
2023	2241	4357	$217.46	$423.54	$0.00	5%
2024	2353	4574	$228.33	$444.72	$0.00	5%
2025	2471	4803	$239.75	$466.95	$0.00	5%



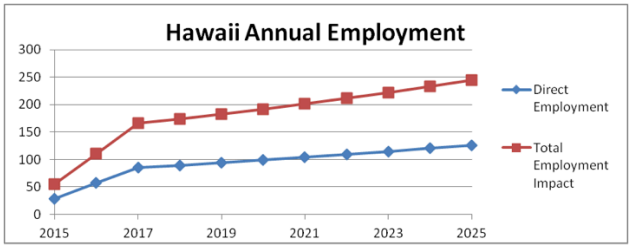


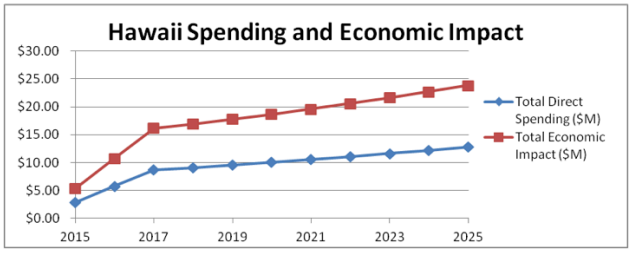
Georgia Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	334	650	$32.87	$63.16	$619.23	
2016	668	1299	$65.74	$126.33	$1,238.46	100%
2017	1003	1949	$98.61	$189.49	$1,857.69	50%
2018	1053	2047	$103.54	$198.97	$1,950.57	5%
2019	1106	2149	$108.72	$208.92	$2,048.10	5%
2020	1161	2256	$114.16	$219.36	$2,150.51	5%
2021	1219	2369	$119.86	$230.33	$2,258.03	5%
2022	1280	2488	$125.86	$241.85	$2,370.94	5%
2023	1344	2612	$132.15	$253.94	$2,489.48	5%
2024	1411	2743	$138.76	$266.64	$2,613.96	5%
2025	1481	2880	$145.70	$279.97	$2,744.65	5%



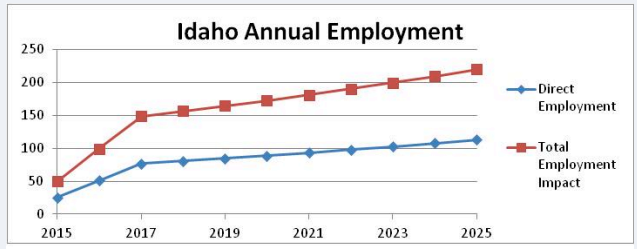


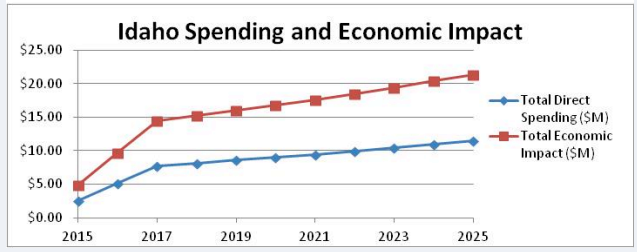
Hawaii Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	28	55	$2.89	$5.38	$65.11	
2016	57	111	$5.78	$10.76	$130.22	100%
2017	85	166	$8.67	$16.14	$195.33	50%
2018	90	174	$9.11	$16.94	$205.09	5%
2019	94	183	$9.56	$17.79	$215.35	5%
2020	99	192	$10.04	$18.68	$226.12	5%
2021	104	202	$10.54	$19.61	$237.42	5%
2022	109	212	$11.07	$20.59	$249.29	5%
2023	114	222	$11.62	$21.62	$261.76	5%
2024	120	234	$12.20	$22.70	$274.84	5%
2025	126	245	$12.81	$23.84	$288.59	5%



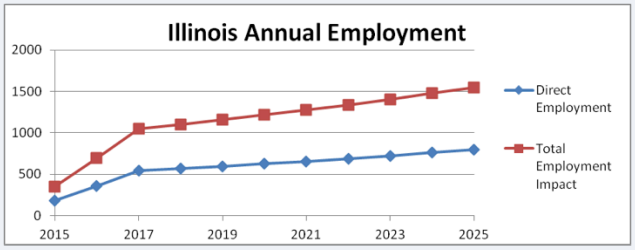


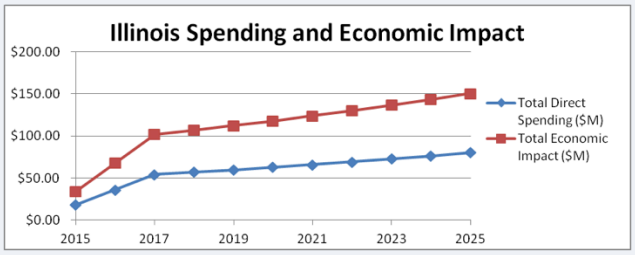
Idaho Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	26	50	$2.59	$4.82	$59.97	
2016	51	99	$5.18	$9.64	$119.93	100%
2017	77	149	$7.78	$14.47	$179.90	50%
2018	80	156	$8.17	$15.19	$188.89	5%
2019	84	164	$8.57	$15.95	$198.34	5%
2020	89	172	$9.00	$16.75	$208.26	5%
2021	93	181	$9.45	$17.58	$218.67	5%
2022	98	190	$9.93	$18.46	$229.60	5%
2023	103	199	$10.42	$19.39	$241.08	5%
2024	108	209	$10.94	$20.36	$253.14	5%
2025	113	220	$11.49	$21.37	$265.79	5%



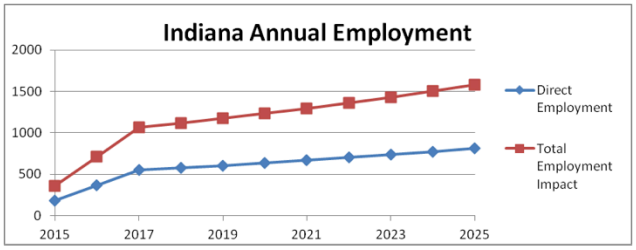


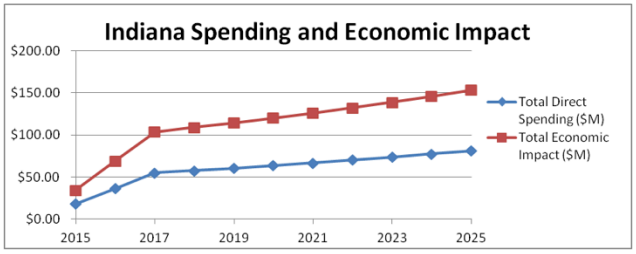
Illinois Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	180	350	$18.12	$33.98	$285.38	
2016	360	699	$36.24	$67.96	$570.76	100%
2017	539	1049	$54.36	$101.93	$856.13	50%
2018	566	1101	$57.08	$107.03	$898.94	5%
2019	595	1156	$59.94	$112.38	$943.89	5%
2020	624	1214	$62.93	$118.00	$991.08	5%
2021	656	1274	$66.08	$123.90	$1,040.64	5%
2022	688	1338	$69.38	$130.10	$1,092.67	5%
2023	723	1405	$72.85	$136.60	$1,147.30	5%
2024	759	1475	$76.50	$143.43	$1,204.67	5%
2025	797	1549	$80.32	$150.60	$1,264.90	5%



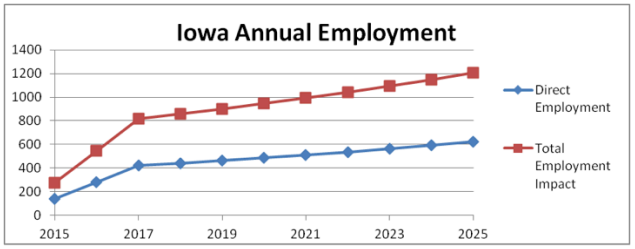


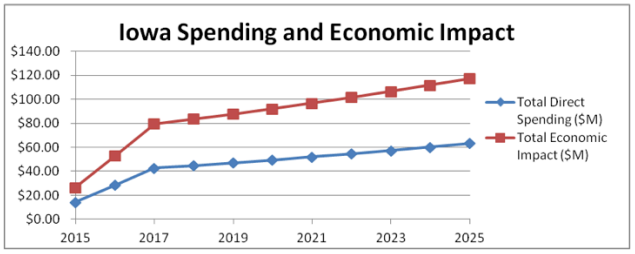
Indiana Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	183	356	$18.35	$34.58	$197.47	
2016	366	711	$36.69	$69.17	$394.93	100%
2017	549	1067	$55.04	$103.75	$592.40	50%
2018	576	1121	$57.79	$108.94	$622.02	5%
2019	605	1177	$60.68	$114.39	$653.12	5%
2020	636	1235	$63.72	$120.11	$685.77	5%
2021	667	1297	$66.90	$126.11	$720.06	5%
2022	701	1362	$70.25	$132.42	$756.06	5%
2023	736	1430	$73.76	$139.04	$793.87	5%
2024	773	1502	$77.45	$145.99	$833.56	5%
2025	811	1577	$81.32	$153.29	$875.24	5%



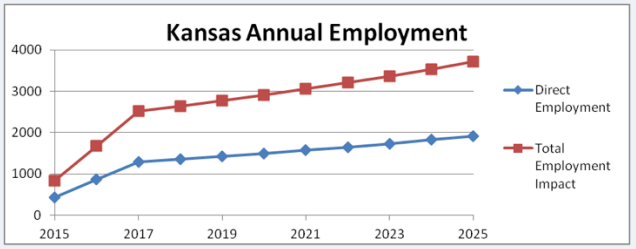


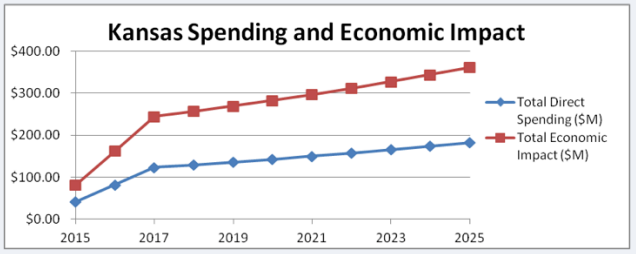
Iowa Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	140	272	$14.25	$26.49	$153.36	
2016	280	545	$28.50	$52.97	$306.72	100%
2017	420	817	$42.75	$79.46	$460.08	50%
2018	441	858	$44.88	$83.44	$483.08	5%
2019	464	901	$47.13	$87.61	$507.24	5%
2020	487	946	$49.48	$91.99	$532.60	5%
2021	511	994	$51.96	$96.59	$559.23	5%
2022	537	1043	$54.56	$101.42	$587.19	5%
2023	563	1095	$57.28	$106.49	$616.55	5%
2024	592	1150	$60.15	$111.81	$647.38	5%
2025	621	1208	$63.16	$117.40	$679.75	5%



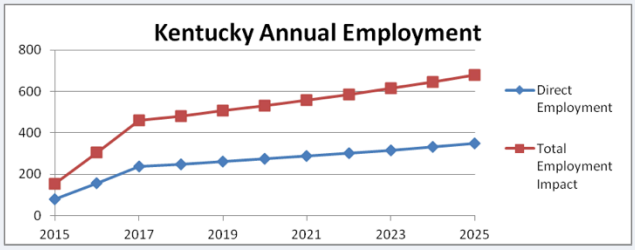


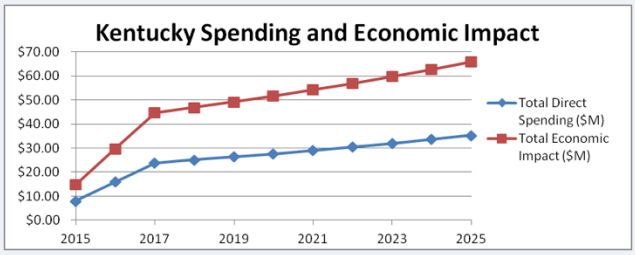
Kansas Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	431	838	$41.18	$81.50	$807.44	
2016	863	1677	$82.36	$163.01	$1,614.89	100%
2017	1294	2515	$123.54	$244.51	$2,422.33	50%
2018	1359	2641	$129.72	$256.73	$2,543.45	5%
2019	1426	2773	$136.20	$269.57	$2,670.62	5%
2020	1498	2911	$143.01	$283.05	$2,804.15	5%
2021	1573	3057	$150.16	$297.20	$2,944.36	5%
2022	1651	3210	$157.67	$312.06	$3,091.58	5%
2023	1734	3370	$165.55	$327.66	$3,246.16	5%
2024	1821	3539	$173.83	$344.05	$3,408.47	5%
2025	1912	3716	$182.52	$361.25	$3,578.89	5%



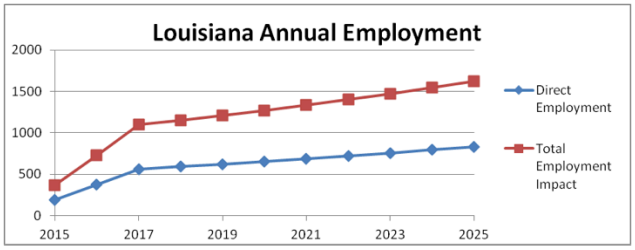


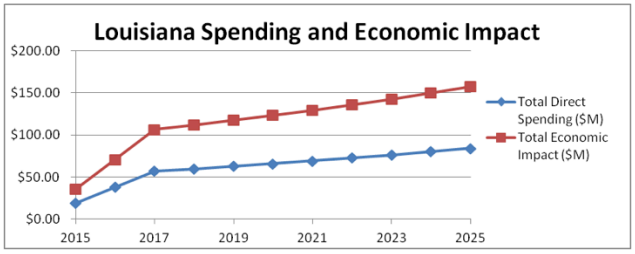
Kentucky Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	79	153	$7.96	$14.87	$149.97	
2016	157	306	$15.92	$29.74	$299.93	100%
2017	236	459	$23.88	$44.61	$449.90	50%
2018	248	482	$25.08	$46.84	$472.39	5%
2019	260	506	$26.33	$49.19	$496.01	5%
2020	273	531	$27.65	$51.65	$520.81	5%
2021	287	558	$29.03	$54.23	$546.85	5%
2022	301	586	$30.48	$56.94	$574.19	5%
2023	316	615	$32.00	$59.79	$602.90	5%
2024	332	646	$33.60	$62.78	$633.05	5%
2025	349	678	$35.28	$65.92	$664.70	5%



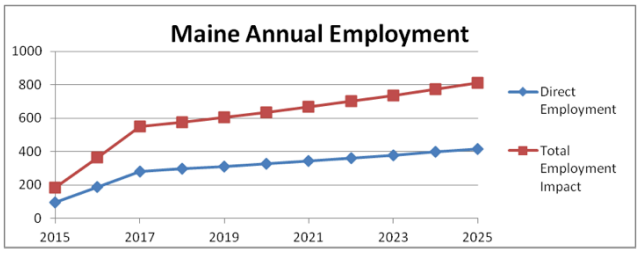


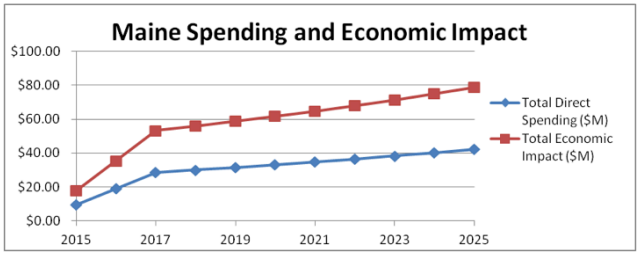
Louisiana Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	188	366	$19.02	$35.54	$240.37	
2016	376	731	$38.04	$71.07	$480.75	100%
2017	564	1097	$57.06	$106.61	$721.12	50%
2018	592	1151	$59.91	$111.94	$757.18	5%
2019	622	1209	$62.91	$117.54	$795.04	5%
2020	653	1269	$66.05	$123.41	$834.79	5%
2021	686	1333	$69.36	$129.58	$876.53	5%
2022	720	1400	$72.82	$136.06	$920.35	5%
2023	756	1470	$76.46	$142.87	$966.37	5%
2024	794	1543	$80.29	$150.01	$1,014.69	5%
2025	833	1620	$84.30	$157.51	$1,065.42	5%



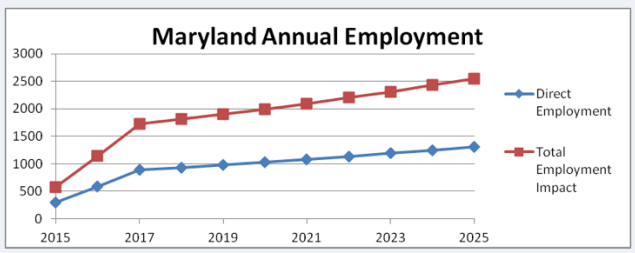


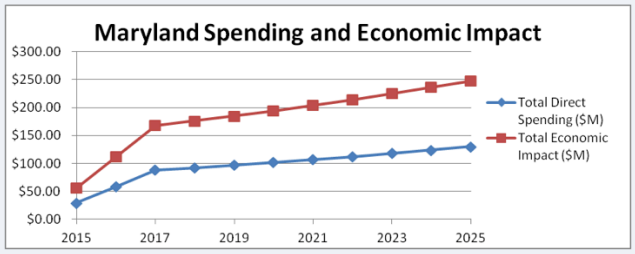
Maine Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	94	183	$9.56	$17.76	$209.43	
2016	188	365	$19.12	$35.53	$418.86	100%
2017	282	548	$28.68	$53.29	$628.29	50%
2018	296	576	$30.11	$55.96	$659.71	5%
2019	311	604	$31.62	$58.76	$692.69	5%
2020	326	635	$33.20	$61.69	$727.33	5%
2021	343	666	$34.86	$64.78	$763.70	5%
2022	360	700	$36.60	$68.02	$801.88	5%
2023	378	735	$38.43	$71.42	$841.97	5%
2024	397	771	$40.35	$74.99	$884.07	5%
2025	417	810	$42.37	$78.74	$928.28	5%



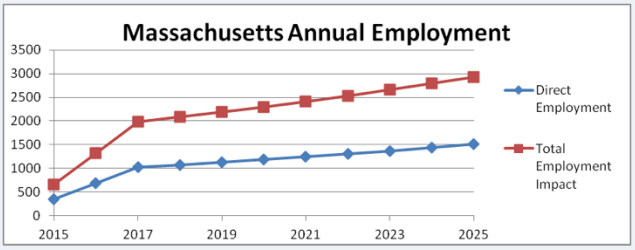


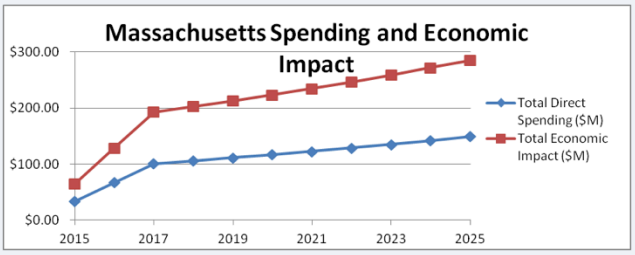
Maryland Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	296	575	$29.33	$55.91	$439.20	
2016	592	1150	$58.67	$111.83	$878.39	100%
2017	888	1725	$88.00	$167.74	$1,317.59	50%
2018	932	1812	$92.40	$176.13	$1,383.46	5%
2019	979	1902	$97.02	$184.93	$1,452.64	5%
2020	1028	1997	$101.87	$194.18	$1,525.27	5%
2021	1079	2097	$106.97	$203.89	$1,601.53	5%
2022	1133	2202	$112.31	$214.08	$1,681.61	5%
2023	1190	2312	$117.93	$224.79	$1,765.69	5%
2024	1249	2428	$123.83	$236.02	$1,853.98	5%
2025	1311	2549	$130.02	$247.83	$1,946.67	5%



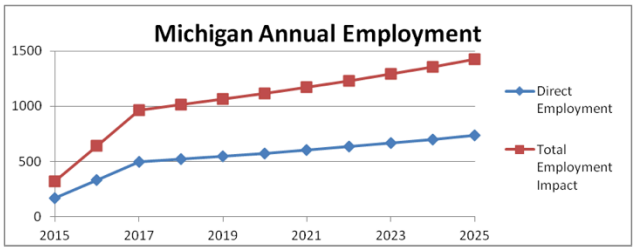


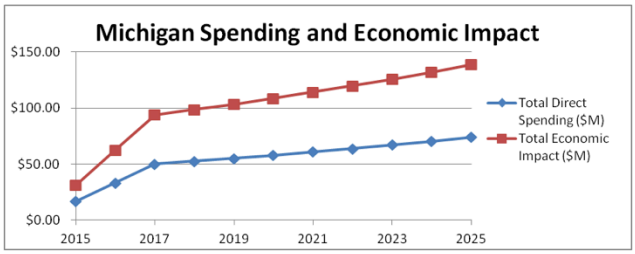
Massachusetts Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	340	662	$33.61	$64.33	$560.47	
2016	681	1323	$67.21	$128.66	$1,120.95	100%
2017	1021	1985	$100.82	$192.99	$1,681.42	50%
2018	1072	2084	$105.86	$202.64	$1,765.49	5%
2019	1126	2189	$111.16	$212.77	$1,853.76	5%
2020	1182	2298	$116.71	$223.41	$1,946.45	5%
2021	1241	2413	$122.55	$234.58	$2,043.78	5%
2022	1303	2534	$128.68	$246.31	$2,145.96	5%
2023	1369	2660	$135.11	$258.63	$2,253.26	5%
2024	1437	2793	$141.87	$271.56	$2,365.93	5%
2025	1509	2933	$148.96	$285.14	$2,484.22	5%



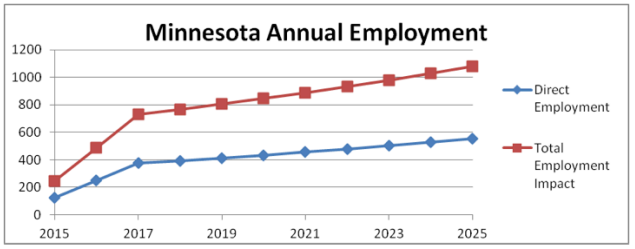


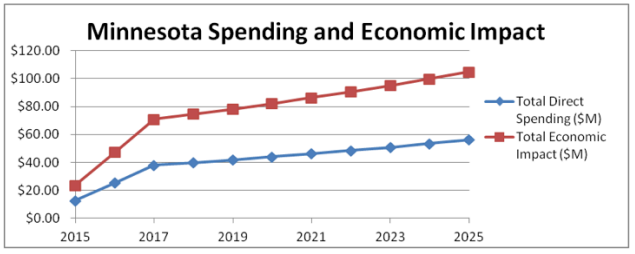
Michigan Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	165	322	$16.68	$31.27	$228.98	
2016	331	643	$33.36	$62.54	$457.95	100%
2017	496	965	$50.04	$93.81	$686.93	50%
2018	521	1013	$52.54	$98.50	$721.28	5%
2019	547	1064	$55.16	$103.42	$757.34	5%
2020	575	1117	$57.92	$108.59	$795.21	5%
2021	603	1173	$60.82	$114.02	$834.97	5%
2022	633	1231	$63.86	$119.72	$876.71	5%
2023	665	1293	$67.05	$125.71	$920.55	5%
2024	698	1358	$70.40	$131.99	$966.58	5%
2025	733	1426	$73.92	$138.59	$1,014.91	5%



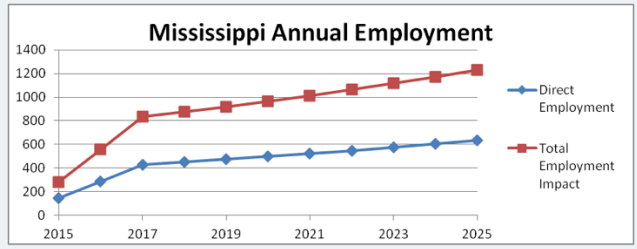


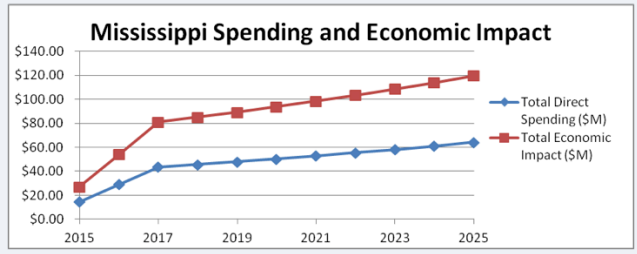
Minnesota Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	125	243	$12.66	$23.65	$279.35	
2016	250	487	$25.32	$47.30	$558.70	100%
2017	375	730	$37.99	$70.95	$838.05	50%
2018	394	766	$39.88	$74.49	$879.95	5%
2019	414	805	$41.88	$78.22	$923.95	5%
2020	435	845	$43.97	$82.13	$970.15	5%
2021	456	887	$46.17	$86.24	$1,018.66	5%
2022	479	931	$48.48	$90.55	$1,069.59	5%
2023	503	978	$50.90	$95.07	$1,123.07	5%
2024	528	1027	$53.45	$99.83	$1,179.22	5%
2025	555	1078	$56.12	$104.82	$1,238.18	5%



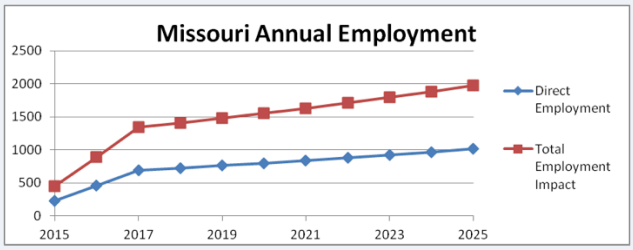


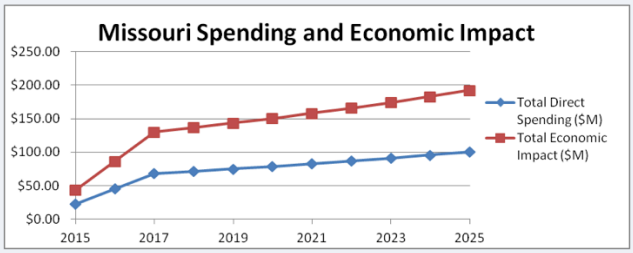
Mississippi Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	143	277	$14.48	$26.97	$183.05	
2016	285	555	$28.97	$53.94	$366.09	100%
2017	428	832	$43.45	$80.91	$549.14	50%
2018	450	874	$45.62	$84.95	$576.59	5%
2019	472	918	$47.90	$89.20	$605.42	5%
2020	496	963	$50.30	$93.66	$635.69	5%
2021	520	1012	$52.81	$98.35	$667.48	5%
2022	546	1062	$55.46	$103.26	$700.85	5%
2023	574	1115	$58.23	$108.43	$735.90	5%
2024	602	1171	$61.14	$113.85	$772.69	5%
2025	633	1230	$64.20	$119.54	$811.33	5%



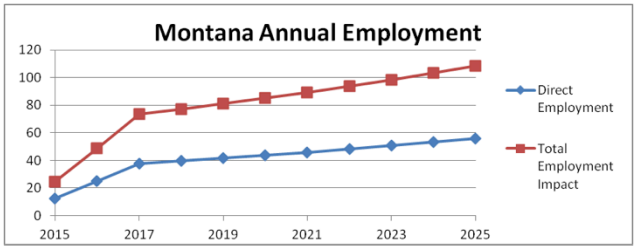


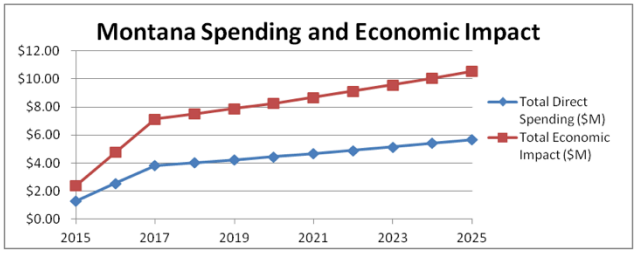
Missouri Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	230	446	$22.75	$43.38	$287.55	
2016	459	892	$45.50	$86.75	$575.10	100%
2017	689	1338	$68.26	$130.13	$862.65	50%
2018	723	1405	$71.67	$136.63	$905.79	5%
2019	759	1476	$75.25	$143.46	$951.07	5%
2020	797	1549	$79.02	$150.64	$998.63	5%
2021	837	1627	$82.97	$158.17	$1,048.56	5%
2022	879	1708	$87.12	$166.08	$1,100.99	5%
2023	923	1794	$91.47	$174.38	$1,156.04	5%
2024	969	1883	$96.05	$183.10	$1,213.84	5%
2025	1017	1978	$100.85	$192.26	$1,274.53	5%



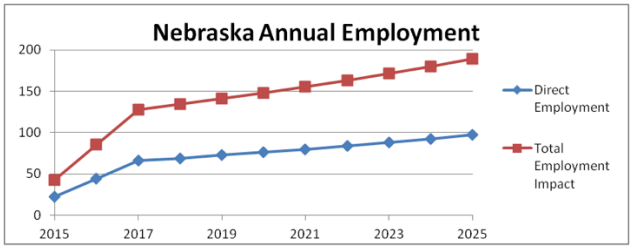


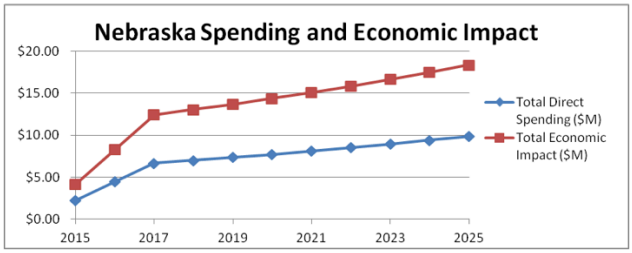
Montana Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	13	25	$1.28	$2.38	$25.33	
2016	25	49	$2.56	$4.76	$50.66	100%
2017	38	74	$3.84	$7.15	$75.98	50%
2018	40	77	$4.04	$7.50	$79.78	5%
2019	42	81	$4.24	$7.88	$83.77	5%
2020	44	85	$4.45	$8.27	$87.96	5%
2021	46	89	$4.67	$8.69	$92.36	5%
2022	48	94	$4.91	$9.12	$96.98	5%
2023	51	99	$5.15	$9.58	$101.82	5%
2024	53	103	$5.41	$10.06	$106.92	5%
2025	56	109	$5.68	$10.56	$112.26	5%



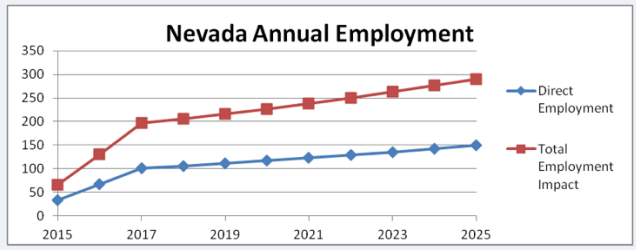


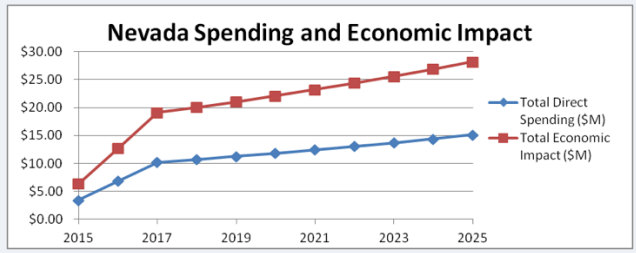
Nebraska Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	22	43	$2.23	$4.14	$35.91	
2016	44	85	$4.46	$8.29	$71.82	100%
2017	66	128	$6.68	$12.43	$107.73	50%
2018	69	134	$7.02	$13.05	$113.11	5%
2019	73	141	$7.37	$13.70	$118.77	5%
2020	76	148	$7.74	$14.39	$124.71	5%
2021	80	155	$8.12	$15.11	$130.94	5%
2022	84	163	$8.53	$15.86	$137.49	5%
2023	88	171	$8.96	$16.66	$144.37	5%
2024	93	180	$9.40	$17.49	$151.58	5%
2025	97	189	$9.87	$18.37	$159.16	5%



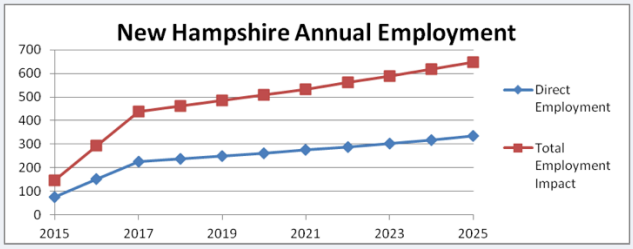


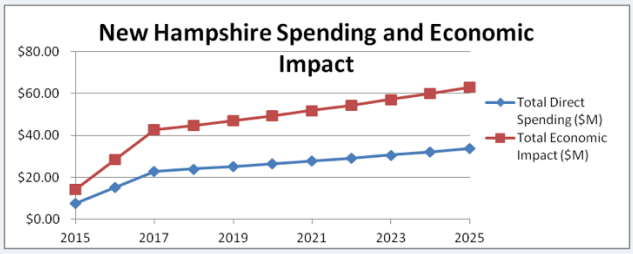
Nevada Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	34	65	$3.41	$6.36	$0.00	
2016	67	131	$6.81	$12.72	$0.00	100%
2017	101	196	$10.22	$19.08	$0.00	50%
2018	106	206	$10.73	$20.03	$0.00	5%
2019	111	216	$11.27	$21.03	$0.00	5%
2020	117	227	$11.83	$22.08	$0.00	5%
2021	123	238	$12.42	$23.19	$0.00	5%
2022	129	250	$13.04	$24.35	$0.00	5%
2023	135	263	$13.69	$25.56	$0.00	5%
2024	142	276	$14.38	$26.84	$0.00	5%
2025	149	290	$15.10	$28.18	$0.00	5%



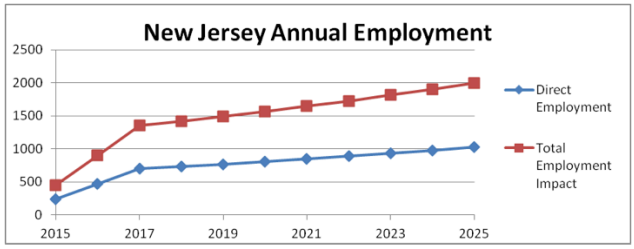


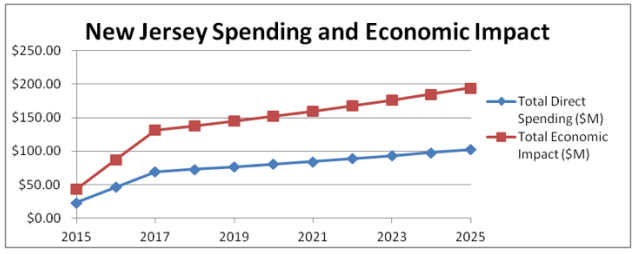
New Hampshire Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	75	146	$7.65	$14.23	$0.00	
2016	151	293	$15.29	$28.47	$0.00	100%
2017	226	439	$22.94	$42.70	$0.00	50%
2018	237	461	$24.09	$44.84	$0.00	5%
2019	249	484	$25.29	$47.08	$0.00	5%
2020	262	508	$26.56	$49.43	$0.00	5%
2021	275	534	$27.89	$51.90	$0.00	5%
2022	288	561	$29.28	$54.50	$0.00	5%
2023	303	589	$30.75	$57.22	$0.00	5%
2024	318	618	$32.28	$60.08	$0.00	5%
2025	334	649	$33.90	$63.09	$0.00	5%



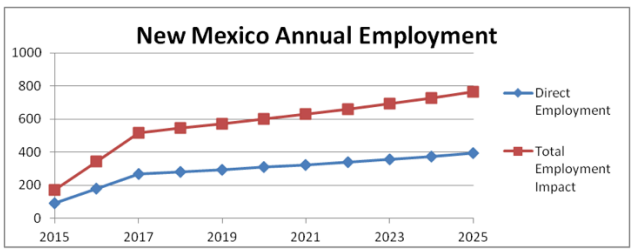


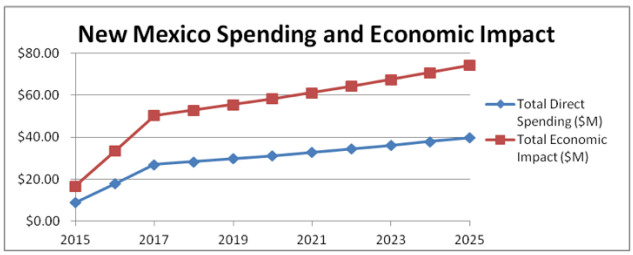
New Jersey Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	232	451	$23.21	$43.84	$540.55	
2016	464	902	$46.43	$87.67	$1,081.10	100%
2017	696	1353	$69.64	$131.51	$1,621.65	50%
2018	731	1420	$73.13	$138.08	$1,702.74	5%
2019	767	1491	$76.78	$144.99	$1,787.87	5%
2020	806	1566	$80.62	$152.24	$1,877.27	5%
2021	846	1644	$84.65	$159.85	$1,971.13	5%
2022	888	1726	$88.89	$167.84	$2,069.69	5%
2023	933	1813	$93.33	$176.23	$2,173.17	5%
2024	979	1903	$98.00	$185.05	$2,281.83	5%
2025	1028	1999	$102.90	$194.30	$2,395.92	5%



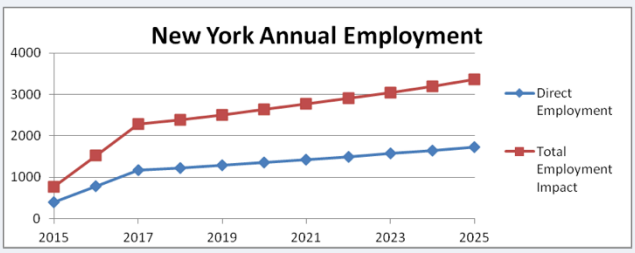


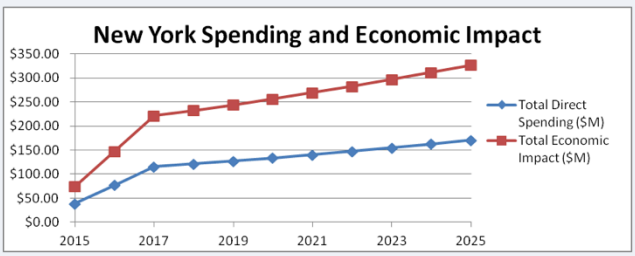
New Mexico Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	89	173	$9.00	$16.78	$122.20	
2016	178	345	$18.01	$33.57	$244.40	100%
2017	266	518	$27.01	$50.35	$366.60	50%
2018	280	544	$28.36	$52.87	$384.93	5%
2019	294	571	$29.78	$55.51	$404.18	5%
2020	308	600	$31.27	$58.29	$424.39	5%
2021	324	630	$32.83	$61.20	$445.60	5%
2022	340	661	$34.47	$64.26	$467.89	5%
2023	357	694	$36.19	$67.47	$491.28	5%
2024	375	729	$38.00	$70.85	$515.84	5%
2025	394	765	$39.90	$74.39	$541.64	5%



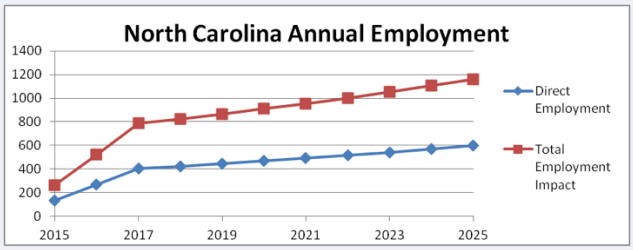


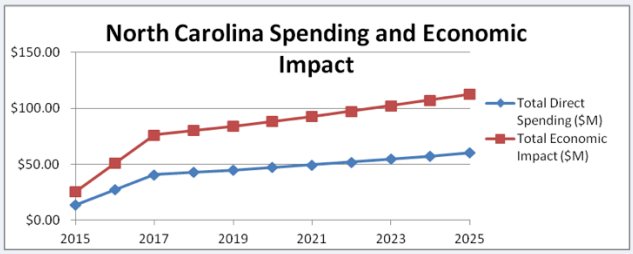
New York Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	390	759	$38.45	$73.76	$777.49	
2016	781	1517	$76.89	$147.51	$1,554.98	100%
2017	1171	2276	$115.34	$221.27	$2,332.46	50%
2018	1229	2390	$121.11	$232.33	$2,449.09	5%
2019	1291	2509	$127.16	$243.95	$2,571.54	5%
2020	1355	2635	$133.52	$256.14	$2,700.12	5%
2021	1423	2766	$140.20	$268.95	$2,835.12	5%
2022	1494	2905	$147.21	$282.40	$2,976.88	5%
2023	1569	3050	$154.57	$296.52	$3,125.73	5%
2024	1648	3203	$162.29	$311.35	$3,282.01	5%
2025	1730	3363	$170.41	$326.91	$3,446.11	5%



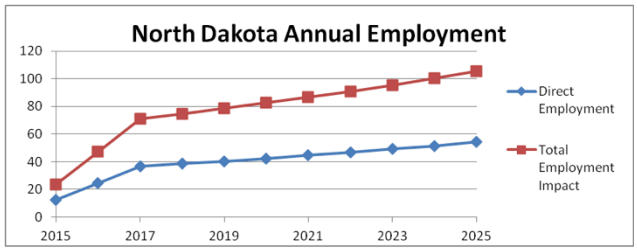


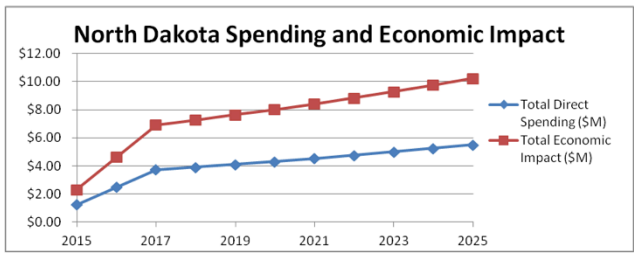
North Carolina Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	135	262	$13.59	$25.44	$297.86	
2016	269	523	$27.19	$50.88	$595.71	100%
2017	404	785	$40.78	$76.31	$893.57	50%
2018	424	824	$42.82	$80.13	$938.25	5%
2019	445	865	$44.97	$84.13	$985.16	5%
2020	467	909	$47.21	$88.34	$1,034.42	5%
2021	491	954	$49.57	$92.76	$1,086.14	5%
2022	515	1002	$52.05	$97.40	$1,140.44	5%
2023	541	1052	$54.66	$102.27	$1,197.47	5%
2024	568	1105	$57.39	$107.38	$1,257.34	5%
2025	597	1160	$60.26	$112.75	$1,320.21	5%



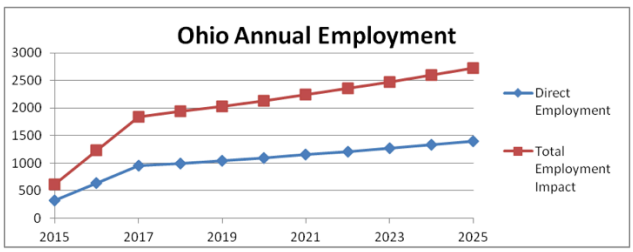


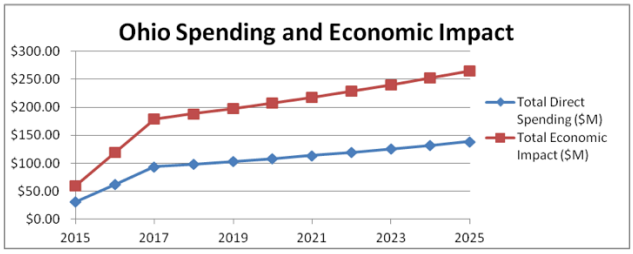
North Dakota Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	12	24	$1.24	$2.31	$11.11	
2016	24	47	$2.48	$4.62	$22.22	100%
2017	37	71	$3.73	$6.93	$33.33	50%
2018	38	75	$3.91	$7.27	$35.00	5%
2019	40	79	$4.11	$7.64	$36.75	5%
2020	42	82	$4.31	$8.02	$38.58	5%
2021	45	87	$4.53	$8.42	$40.51	5%
2022	47	91	$4.76	$8.84	$42.54	5%
2023	49	95	$4.99	$9.28	$44.66	5%
2024	52	100	$5.24	$9.75	$46.90	5%
2025	54	105	$5.51	$10.23	$49.24	5%



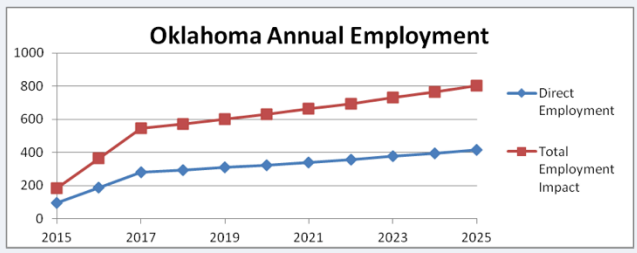


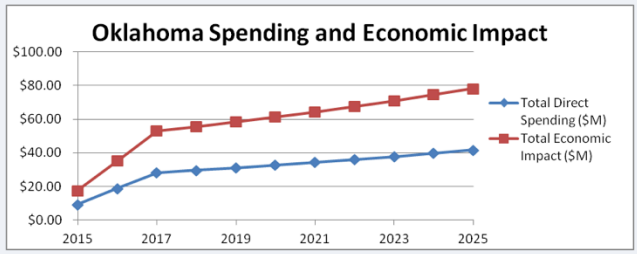
Ohio Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	316	615	$31.25	$59.77	$404.63	
2016	633	1230	$62.49	$119.54	$809.26	100%
2017	949	1844	$93.74	$179.31	$1,213.89	50%
2018	996	1937	$98.42	$188.27	$1,274.59	5%
2019	1046	2033	$103.34	$197.69	$1,338.32	5%
2020	1098	2135	$108.51	$207.57	$1,405.23	5%
2021	1153	2242	$113.94	$217.95	$1,475.50	5%
2022	1211	2354	$119.63	$228.85	$1,549.27	5%
2023	1272	2472	$125.62	$240.29	$1,626.73	5%
2024	1335	2595	$131.90	$252.30	$1,708.07	5%
2025	1402	2725	$138.49	$264.92	$1,793.47	5%



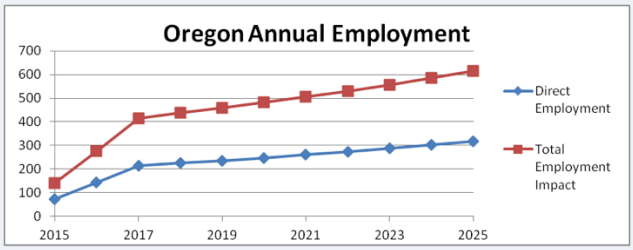


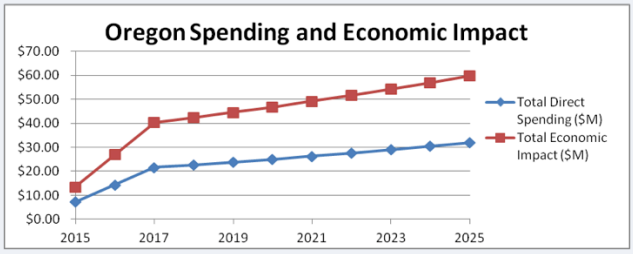
Oklahoma Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	93	182	$9.41	$17.65	$155.51	
2016	187	363	$18.82	$35.30	$311.02	100%
2017	280	545	$28.24	$52.95	$466.53	50%
2018	294	572	$29.65	$55.60	$489.85	5%
2019	309	600	$31.13	$58.38	$514.35	5%
2020	324	631	$32.69	$61.30	$540.06	5%
2021	341	662	$34.32	$64.36	$567.07	5%
2022	358	695	$36.04	$67.58	$595.42	5%
2023	375	730	$37.84	$70.96	$625.19	5%
2024	394	766	$39.73	$74.51	$656.45	5%
2025	414	805	$41.72	$78.23	$689.27	5%



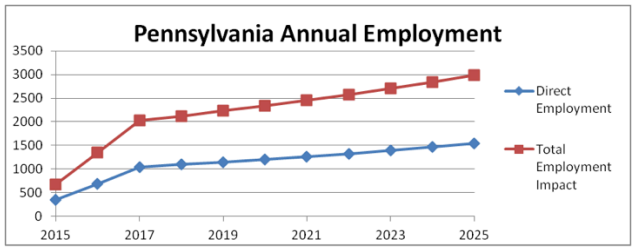


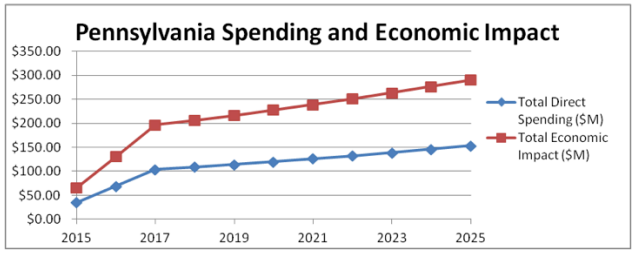
Oregon Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	71	139	$7.21	$13.48	$68.59	
2016	143	277	$14.43	$26.96	$137.18	100%
2017	214	416	$21.64	$40.43	$205.77	50%
2018	225	437	$22.72	$42.46	$216.06	5%
2019	236	459	$23.86	$44.58	$226.86	5%
2020	248	481	$25.05	$46.81	$238.20	5%
2021	260	506	$26.30	$49.15	$250.11	5%
2022	273	531	$27.62	$51.61	$262.62	5%
2023	287	557	$29.00	$54.19	$275.75	5%
2024	301	585	$30.45	$56.90	$289.54	5%
2025	316	614	$31.97	$59.74	$304.01	5%



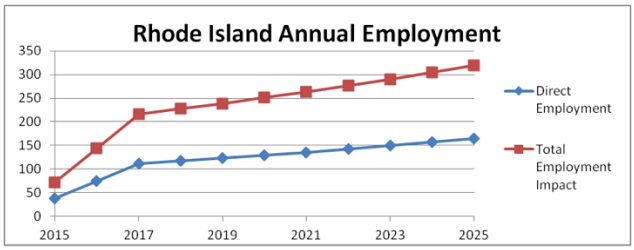


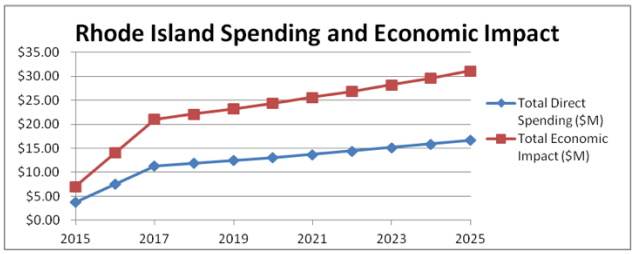
Pennsylvania Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	347	674	$34.53	$65.49	$335.94	
2016	693	1347	$69.06	$130.97	$671.88	100%
2017	1040	2021	$103.60	$196.46	$1,007.82	50%
2018	1092	2122	$108.77	$206.28	$1,058.21	5%
2019	1146	2228	$114.21	$216.59	$1,111.12	5%
2020	1203	2339	$119.92	$227.42	$1,166.67	5%
2021	1264	2456	$125.92	$238.80	$1,225.01	5%
2022	1327	2579	$132.22	$250.74	$1,286.26	5%
2023	1393	2708	$138.83	$263.27	$1,350.57	5%
2024	1463	2843	$145.77	$276.44	$1,418.10	5%
2025	1536	2986	$153.06	$290.26	$1,489.00	5%



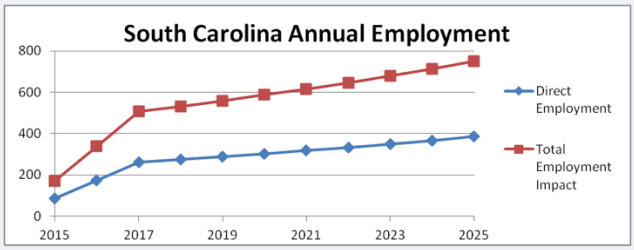


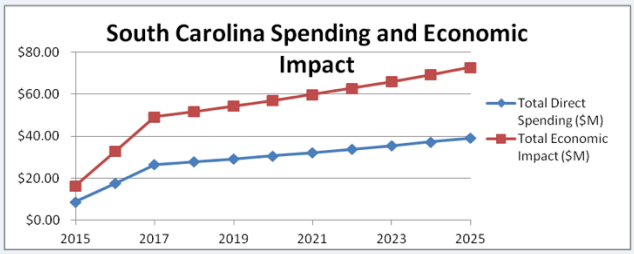
Rhode Island Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	37	72	$3.77	$7.02	$63.33	
2016	74	144	$7.53	$14.04	$126.65	100%
2017	111	217	$11.30	$21.06	$189.98	50%
2018	117	227	$11.86	$22.11	$199.48	5%
2019	123	239	$12.46	$23.22	$209.45	5%
2020	129	251	$13.08	$24.38	$219.92	5%
2021	135	263	$13.73	$25.60	$230.92	5%
2022	142	276	$14.42	$26.88	$242.46	5%
2023	149	290	$15.14	$28.22	$254.59	5%
2024	157	305	$15.90	$29.63	$267.32	5%
2025	165	320	$16.69	$31.12	$280.68	5%



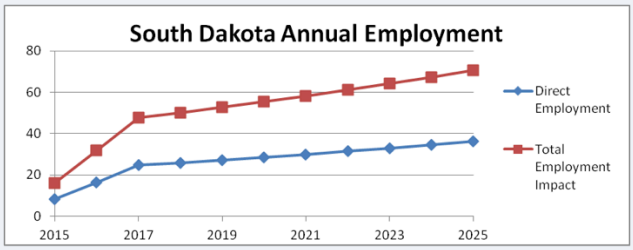


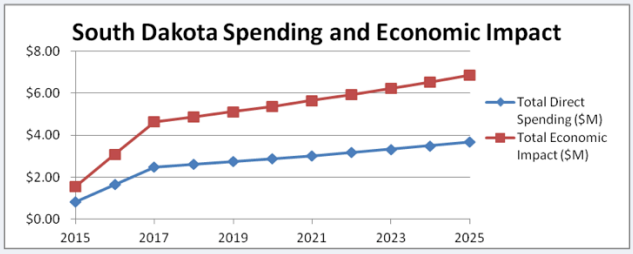
South Carolina Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	87	169	$8.84	$16.43	$193.68	
2016	174	338	$17.68	$32.86	$387.36	100%
2017	261	507	$26.52	$49.29	$581.04	50%
2018	274	532	$27.85	$51.75	$610.09	5%
2019	288	559	$29.24	$54.34	$640.60	5%
2020	302	587	$30.70	$57.06	$672.63	5%
2021	317	616	$32.24	$59.91	$706.26	5%
2022	333	647	$33.85	$62.91	$741.57	5%
2023	350	679	$35.54	$66.05	$778.65	5%
2024	367	713	$37.32	$69.35	$817.58	5%
2025	385	749	$39.18	$72.82	$858.46	5%



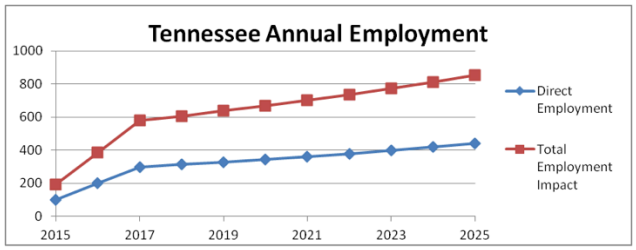


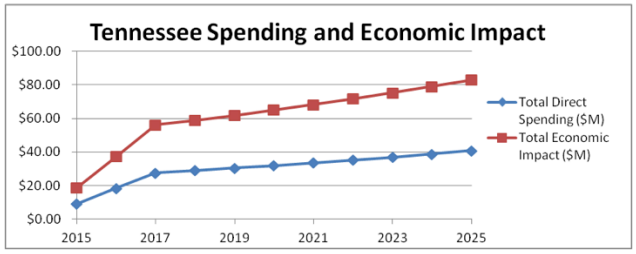
South Dakota Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	8	16	$0.83	$1.55	$0.00	
2016	16	32	$1.66	$3.10	$0.00	100%
2017	25	48	$2.49	$4.65	$0.00	50%
2018	26	50	$2.62	$4.88	$0.00	5%
2019	27	53	$2.75	$5.13	$0.00	5%
2020	28	55	$2.88	$5.38	$0.00	5%
2021	30	58	$3.03	$5.65	$0.00	5%
2022	31	61	$3.18	$5.94	$0.00	5%
2023	33	64	$3.34	$6.23	$0.00	5%
2024	35	67	$3.50	$6.54	$0.00	5%
2025	36	71	$3.68	$6.87	$0.00	5%



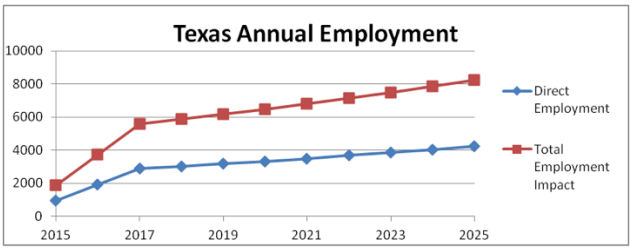


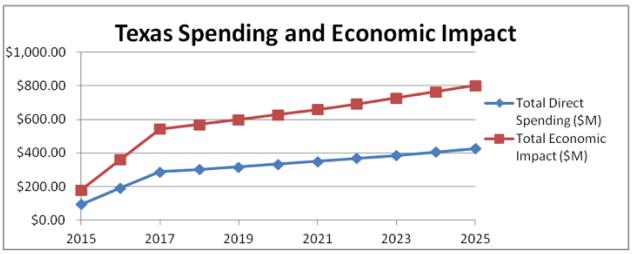
Tennessee Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	99	193	$9.20	$18.72	$0.00	
2016	198	385	$18.40	$37.44	$0.00	100%
2017	297	578	$27.61	$56.15	$0.00	50%
2018	312	606	$28.99	$58.96	$0.00	5%
2019	328	637	$30.43	$61.91	$0.00	5%
2020	344	669	$31.96	$65.01	$0.00	5%
2021	361	702	$33.55	$68.26	$0.00	5%
2022	379	737	$35.23	$71.67	$0.00	5%
2023	398	774	$36.99	$75.25	$0.00	5%
2024	418	813	$38.84	$79.02	$0.00	5%
2025	439	853	$40.79	$82.97	$0.00	5%



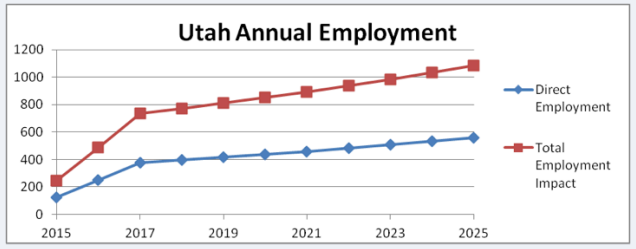


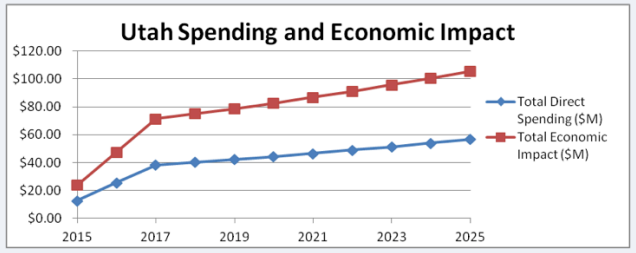
Texas Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	958	1863	$96.15	$181.08	$0.00	
2016	1916	3725	$192.30	$362.17	$0.00	100%
2017	2875	5588	$288.44	$543.25	$0.00	50%
2018	3018	5867	$302.87	$570.42	$0.00	5%
2019	3169	6161	$318.01	$598.94	$0.00	5%
2020	3328	6469	$333.91	$628.89	$0.00	5%
2021	3494	6792	$350.61	$660.33	$0.00	5%
2022	3669	7132	$368.14	$693.35	$0.00	5%
2023	3852	7488	$386.54	$728.01	$0.00	5%
2024	4045	7863	$405.87	$764.41	$0.00	5%
2025	4247	8256	$426.16	$802.63	$0.00	5%



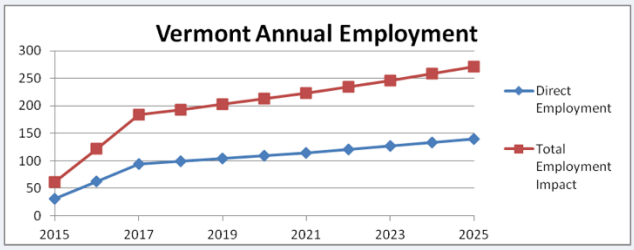


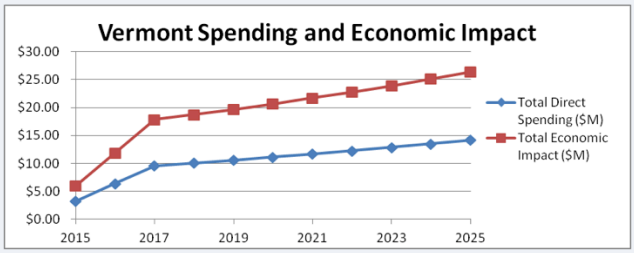
Utah Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	126	245	$12.79	$23.81	$201.35	
2016	252	490	$25.57	$47.61	$402.69	100%
2017	378	735	$38.36	$71.42	$604.04	50%
2018	397	771	$40.27	$74.99	$634.24	5%
2019	417	810	$42.29	$78.74	$665.95	5%
2020	437	850	$44.40	$82.67	$699.25	5%
2021	459	893	$46.62	$86.81	$734.21	5%
2022	482	938	$48.95	$91.15	$770.92	5%
2023	506	984	$51.40	$95.70	$809.47	5%
2024	532	1034	$53.97	$100.49	$849.94	5%
2025	558	1085	$56.67	$105.51	$892.44	5%



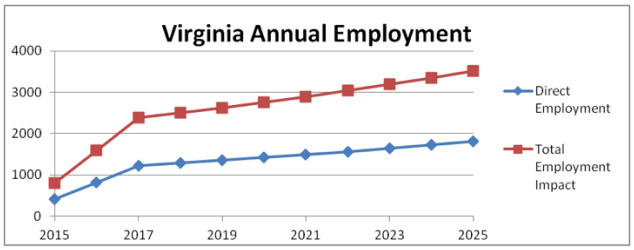


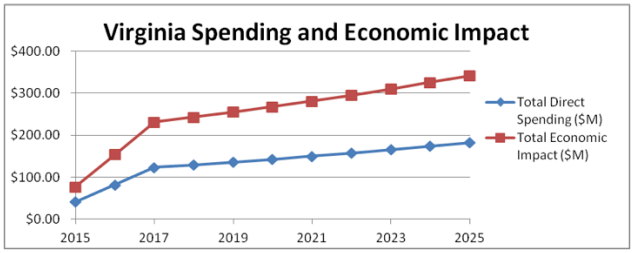
Vermont Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	31	61	$3.20	$5.95	$77.97	
2016	63	122	$6.40	$11.90	$155.94	100%
2017	94	184	$9.61	$17.84	$233.91	50%
2018	99	193	$10.09	$18.74	$245.61	5%
2019	104	202	$10.59	$19.67	$257.89	5%
2020	109	212	$11.12	$20.66	$270.78	5%
2021	115	223	$11.68	$21.69	$284.32	5%
2022	121	234	$12.26	$22.78	$298.54	5%
2023	127	246	$12.87	$23.91	$313.47	5%
2024	133	258	$13.52	$25.11	$329.14	5%
2025	140	271	$14.19	$26.37	$345.60	5%



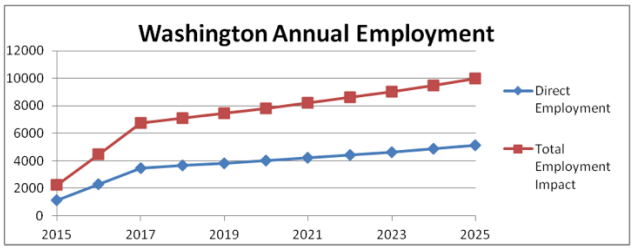


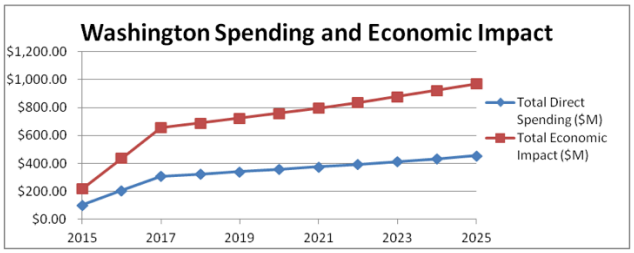
Virginia Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	408	793	$41.21	$77.14	$744.50	
2016	816	1587	$82.41	$154.28	$1,489.00	100%
2017	1225	2380	$123.62	$231.42	$2,233.51	50%
2018	1286	2499	$129.80	$242.99	$2,345.18	5%
2019	1350	2624	$136.29	$255.14	$2,462.44	5%
2020	1418	2756	$143.11	$267.89	$2,585.56	5%
2021	1489	2893	$150.26	$281.29	$2,714.84	5%
2022	1563	3038	$157.77	$295.35	$2,850.58	5%
2023	1641	3190	$165.66	$310.12	$2,993.11	5%
2024	1723	3349	$173.95	$325.63	$3,142.77	5%
2025	1809	3517	$182.64	$341.91	$3,299.90	5%



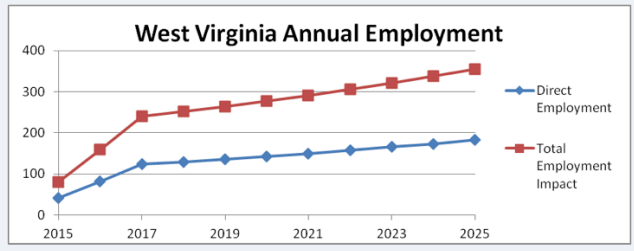


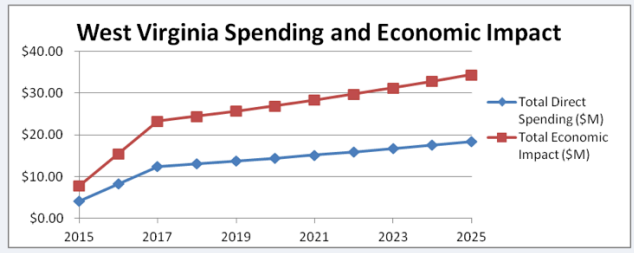
Washington Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	1157	2249	$102.88	$218.61	$0.00	
2016	2314	4497	$205.76	$437.23	$0.00	100%
2017	3470	6746	$308.63	$655.84	$0.00	50%
2018	3644	7083	$324.06	$688.64	$0.00	5%
2019	3826	7438	$340.27	$723.07	$0.00	5%
2020	4017	7809	$357.28	$759.22	$0.00	5%
2021	4218	8200	$375.14	$797.18	$0.00	5%
2022	4429	8610	$393.90	$837.04	$0.00	5%
2023	4651	9040	$413.60	$878.89	$0.00	5%
2024	4883	9492	$434.28	$922.84	$0.00	5%
2025	5127	9967	$455.99	$968.98	$0.00	5%





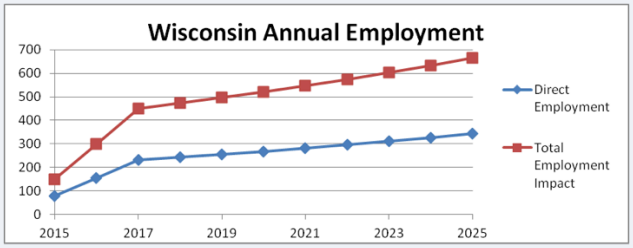
West Virginia Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	41	80	$4.16	$7.77	$78.42	
2016	82	160	$8.33	$15.54	$156.84	100%
2017	123	240	$12.49	$23.31	$235.26	50%
2018	129	252	$13.11	$24.47	$247.03	5%
2019	136	264	$13.77	$25.70	$259.38	5%
2020	143	278	$14.46	$26.98	$272.35	5%
2021	150	291	$15.18	$28.33	$285.96	5%
2022	157	306	$15.94	$29.75	$300.26	5%
2023	165	321	$16.74	$31.23	$315.28	5%
2024	174	337	$17.57	$32.79	$331.04	5%
2025	182	354	$18.45	$34.43	$347.59	5%

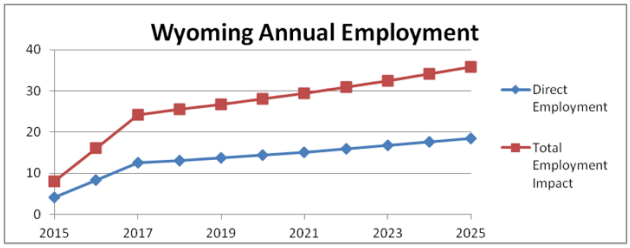


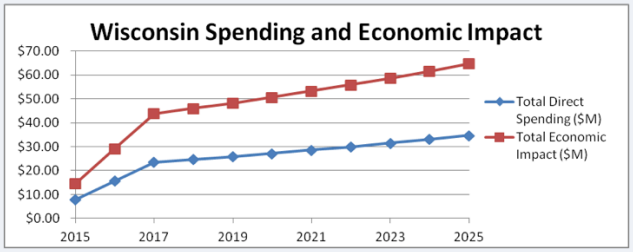


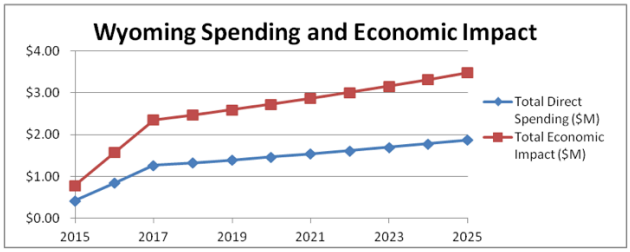
Wisconsin Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	77	150	$7.83	$14.59	$159.52	
2016	154	300	$15.66	$29.19	$319.05	100%
2017	232	450	$23.49	$43.78	$478.57	50%
2018	243	473	$24.66	$45.97	$502.50	5%
2019	255	497	$25.89	$48.27	$527.62	5%
2020	268	521	$27.19	$50.69	$554.01	5%
2021	282	547	$28.55	$53.22	$581.71	5%
2022	296	575	$29.98	$55.88	$610.79	5%
2023	310	604	$31.47	$58.67	$641.33	5%
2024	326	634	$33.05	$61.61	$673.40	5%
2025	342	665	$34.70	$64.69	$707.07	5%

Wyoming Economic Impact						
Year	Direct Employment	Total Employment Impact	Total Direct Spending ($M)	Total Economic Impact ($M)	Total State Taxes ($K)	Percent Change Over Previous Year
2015	4	8	$0.42	$0.79	$0.00	
2016	8	16	$0.85	$1.57	$0.00	100%
2017	12	24	$1.27	$2.36	$0.00	50%
2018	13	25	$1.33	$2.47	$0.00	5%
2019	14	27	$1.40	$2.60	$0.00	5%
2020	14	28	$1.47	$2.73	$0.00	5%
2021	15	29	$1.54	$2.86	$0.00	5%
2022	16	31	$1.62	$3.01	$0.00	5%
2023	17	32	$1.70	$3.16	$0.00	5%
2024	18	34	$1.78	$3.32	$0.00	5%
2025	18	36	$1.87	$3.48	$0.00	5%









** Some states have zero tax revenue, because those states do not have a state income tax.

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AUVSI FAST FACTS

MISSION

The mission of AUVSI is to advance the unmanned systems and robotics community through education, advocacy and leadership.

MEMBERS

AUVSI represents more than 7,000 individual members and more than 600 corporate members from 60+ allied countries involved in the fields of government, industry and academia. AUVSI members work in the defense, civil and commercial markets.

AUVSI ACTIVITIES

EVENTS

- **AUVSI's Unmanned Systems Conference and Exhibition** – More than 8,000 attendees and 600+ exhibitors from more than 40 countries and an average annual growth rate of 20% make this the leading event for the global unmanned systems and robotics marketplace. www.auvsishow.org
- **AUVSI's Unmanned Systems Program Review** – Providing the latest information on government and industry programs for ground, air and maritime systems, this annual event is one of the most important to the unmanned systems community. This is one event where business happens.
- **Networking Events** – AUVSI hosts meetings and events worldwide, providing education and networking opportunities for key industry leaders, including AUVSI's Driverless Car Summit.

ADVOCACY

AUVSI works with its membership to shape policy by advocating on behalf of the unmanned systems industry, monitoring legislation and assessing the impact of the industry. AUVSI plays a key role in addressing critical industry issues, such as National Airspace Access, Frequency Spectrum (GPS), NextGen/SESAR, Coalition Building and First Responder Grants. AUVSI works to influence legislation, including the FAA Reauthorization, Transportation Bill, DOD Reauthorization and Homeland Security Reauthorization.

EDUCATION CAMPAIGN

AUVSI is working hard to change the public perception of the unmanned systems and robotics industry through promotion of our members and the endless applications and benefits of their systems. Part of this campaign includes a public website: www.increasinghumanpotential.org.

PUBLICATIONS

- **Print** - *Unmanned Systems* magazine – A monthly magazine providing current industry news, trends and emerging developments; *Unmanned Systems: Mission Critical* – A quarterly supplement dedicated to unmanned systems sectors that, once tapped, will change the way the world works.
- **Electronic** – *AUVSI's Unmanned Systems eBrief* – A weekly electronic newsletter that includes the latest global industry and association news and information; Flight Unmanned – A biweekly electronic publication of the association for AUVSI members.

ONLINE CAREER CENTER

A leading resource for job-seekers and employers in the unmanned systems and robotics market.

KNOWLEDGE RESOURCES

Through its knowledge services AUVSI promotes vision, intellectual leadership and education in unmanned systems. AUVSI's Knowledge Vault provides AUVSI members a one-stop shop for all AUVSI event proceedings and publications.

AUVSI FOUNDATION

The AUVSI Foundation is a tax-exempt 501(c)3 public charity established to support educational initiatives such as AUVSI's Youth Education Program, discussion groups, forums and other programs. The foundation has provided more than $500,000 to educational programs worldwide. Each year, the AUVSI Foundation hosts and sponsors competitions to challenge students to design, build and deploy autonomous air, ground and maritime systems.

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Unmanned Aircraft Systems:

Current and Future Uses

Past/Current Uses

- **Enhancing Public Safety**
  - Fighting wildfires in California – In 2008, NASA assisted the state of California in fighting wildfires with the use of Ikhana, a UAS equipped with advanced technology. The information about the fires collected by Ilkhana was transmitted to command centers within minutes, and then distributed into the field giving firefighters crucial situational awareness. Throughout the operation, NASA pilots operating Ilkhana were in close communication with the FAA to ensure its safe separation from other aircraft.

  - Finding missing persons in New Mexico – On January 9, 2012, an Oklahoma couple became lost in the White Sands National Monument in New Mexico. UAS were brought in to assist with the search. Once the couple's location was pinpointed, the UAS relayed specific coordinates of the couple and monitored their location and movement as rescue helicopters were en route.

  - Patrolling the U.S.-Mexico border – The U.S. Customs and Border Patrol use unmanned systems to patrol the U.S.-Mexico border, helping prevent drug smuggling and potential terrorist threats. The UAS monitor areas, which would take agents on the ground days to reach.

- **Enabling Scientific Research**
  - NASA studying hurricanes – NASA is launching a three-year project using UAS to monitor hurricanes and help scientists better understand why tropical storms become hurricanes, and what signs predict the metamorphosis. Scientists have been unable to determine why or how some storms strengthen so rapidly. UAS are able to fly straight through hurricane clouds to measure conditions, something manned flights and satellites cannot do.

  - Nicholls State protecting the Gulf Coast – Nicholls State University is using a six-foot UAS to map the Louisiana coast. Louisiana's barrier islands are an important habitat for migratory birds, as well as the first line of defence against hurricanes. Erosion of the island has damaged the habitat, as well as the important protective function the islands serve. By flying more frequently and hover longer than satellites or manned aircraft, the UAS save money and provide a better picture of the situation on the coast.

- **Mitigating Disasters**
  - Helping rescue efforts following Hurricane Katrina – UAS were used to help search and rescue teams in the aftermath of Hurricane Katrina. Scientists from the University of South Florida worked with Florida rescuers in Mississippi, in what was the first known use of small UAS for an actual disaster. Brought in to survey Pearlington, MS, within two hours, the responders had the data from the UAVs showing that no survivors were trapped and that the flood waters from the cresting Pearl River were not posing an additional threat.

  - Surveying damage caused by flooding of the Red River – UAS aided the response to the severe flooding of the Red River in the upper Midwest in April 2011. According to the U.S. Customs and Border Protections Office, which leant the UAS to the effort, the UAS mapped more than 800 nautical miles along the flooded tributaries and basins in Minnesota and North Dakota, and provided streaming video and analysis of the areas affected by the flood such as levee integrity and ice damming. The information

provided by UAS gave forecasters more accurate predictions of when and where the flooding would be at its worst.

- Assessing fallout from the damaged Fukushima nuclear plant – After Japan was struck by a devastating, earthquake-induced tsunami on March 11, 2011, a nuclear facility in Fukushima began to leak dangerous levels of radiation, making it impossible for emergency responders to approach the facility's reactors. A UAS from America was used to fly over the damaged facility and use advanced sensors to help responders gain situational awareness they were prevented from otherwise obtaining due to the radiation.

Potential Future Uses

- **Enhancing Public Safety**
  - Enhancing search and rescue efforts – In January 2012, the Mesa (CO) County Sheriff's office purchased small UAS to assist in search and rescue operations. The UAS can cover wide swaths of land and uses cameras and infrared imaging to send video to ground controllers. The use of UAS is also cheap, with the direct operational cost totaling $3.36 per hour. In addition to aiding search and rescue missions, it could also help fight wildfires by determining hotspots and improving situational awareness.

- **Enabling Scientific Research**
  - Safely tracking fish and wildlife – After colleagues were killed in a helicopter crash, Idaho fish biologist Phil Groves has led an effort to develop small, maneuverable UAS for use tracking fish and wildlife. Currently in a multi-year test, Groves says the use of UAS could be a safer and more affordable way to count fish nests than the traditional way of using helicopters.

- **Mitigating Disasters**
  - Enabling communications following a disaster – The Federal Communications Commission is examining the use of UAS to help with communication relays in the event of a disaster to ensure emergency responders are able to communicate with each other. Following Hurricane Katrina, dozens of 911 call centers were knocked out of commission. UAS could help ensure connectivity until land-based communications are restored.

  - Assisting in oil spill response – The University of Alaska Fairbanks is testing UAS focused on improving oil spill response and clean up capabilities in difficult terrain and conditions. The technology gathers 3-D aerial data to produce a detailed image of the affected area, and allows oil spill responders to complete shoreline clean-up and assessment survey work with minimal impact on the shoreline or critical habitat.

- **Supporting Agriculture**
  - Helping farmers fight disease in crops – Researchers at the University of Florida are developing helicopter-style UAS to help farmers detect diseases and stress in their crops. Using GPS technology, the UAS take photographs and measurements and are proving particularly useful for citrus growers, allowing producers to easily detect tree health problems that aren't visible to the human eye.

- **Expanding Commercial Uses**
  - Monitoring energy infrastructure – Energy companies have been testing small UAS to potentially be used to monitor miles of pipeline and drilling rigs. Rather than using manned helicopters that cost an average of $300 per hour to operate, UAS could provide a more cost-effective alternative. UAS ability to go into areas too hazardous for humans also holds potential for energy companies. The flames produced by crude processing operations can jump as high as 300 feet in seconds, making it too dangerous for manned aircraft to survey maintenance needs without shutting down the operation. Using small UAS, however, allows companies to take pictures of the equipment while the flares are burning.

Unmanned Aircraft Systems Privacy Statement

Unmanned Aircraft Systems (UAS) increase human potential by doing dangerous or difficult tasks safely and efficiently. Whether it is improving agriculture practices and output, helping first responders, advancing scientific research, or making business more efficient, UAS are capable of **saving time, saving money and most importantly, saving lives.**

The Association for Unmanned Vehicle Systems International (AUVSI) supports the development and advancement of UAS technology in a safe and responsible manner, while respecting existing privacy laws and ensuring transparency and accountability. AUVSI does not support additional restrictive legislation that will prohibit, delay, or prevent the use of UAS by our public safety agencies and other end users. AUVSI recognizes this new industry is poised to create over 70,000 new jobs within the first three years of UAS being integrated into the National Airspace System in the United States; however, restrictive legislation will inhibit this new industry.

AUVSI supports:

- Registration of unmanned aircraft and pilots with the Federal Aviation Administration (FAA).
- Enforcement of established law and policy, governing the collection, use, storage, sharing and deletion of data, regardless of how it is collected.
    - These policies should be available for public review.
    - The policies should outline strict accountability for unauthorized use.
    - AUVSI supports the International Association of Chiefs of Police recommended guidelines for UAS operations and their recommendations on data collection, which have been adopted by the Airborne Law Enforcement Association and others.
    - UAS manufacturers shall not be held responsible for improper or illegal use of unmanned aircraft systems.

AUVSI does not condone the use of UAS to illegally spy on people. AUVSI fully supports the prosecution of individuals that violate privacy laws. AUVSI fully supports the 4th Amendment's requirement that a search warrant be obtained prior to the government invading an individual's privacy.

AUVSI is opposed to many of the bills that have been introduced in Congress and at state capitals around the country. These bills would fundamentally change current search warrant requirements, which the courts have ably shaped over the past 225 years. The issue should be focused on the extent to which the government can collect, use and store personal data – which is why transparency and accountability are key.

Instead of focusing on how the government collects information, AUVSI supports an open debate on the government's right to collect, use, store, share, and delete personal data. AUVSI believes information gathered by a UAS should be treated no differently than information gathered by a manned aircraft, or other electronic means.

In 2012, AUVSI recently released the industry's first Code of Conduct which is built around safety, professionalism and respect.

Unmanned Aircraft System Operations

Industry "Code of Conduct"

The emergence of unmanned aircraft systems (UAS) as a resource for a wide variety of public and private applications quite possibly represents one of the most significant advancements to aviation, the scientific community, and public service since the beginning of flight. Rapid advancements in the technology have presented unique challenges and opportunities to the growing UAS industry and to those who support it. The nature of UAS and the environments which they operate, when not managed properly, can and will create issues that need to be addressed. The future of UAS will be linked to the responsible and safe use of these systems. Our industry has an obligation to conduct our operations in a safe manner that minimizes risk and instills confidence in our systems.

For this reason, the Association for Unmanned Vehicle Systems International (AUVSI), offers this Code of Conduct on behalf of the UAS industry for UAS operation. This code is intended to provide our members, and those who design, test, and operate UAS for public and civil use, a set of guidelines and recommendations for safe, non-intrusive operations. Acceptance and adherence to this code will contribute to safety and professionalism and will accelerate public confidence in these systems.

The code is built on three specific themes: Safety, Professionalism, and Respect. Each theme and its associated recommendations represent a "common sense" approach to UAS operations and address many of the concerns expressed by the public and regulators. This code is meant to provide UAS industry manufacturers and users a convenient checklist for operations and a means to demonstrate their obligation to supporting the growth of our industry in a safe and responsible manner. By adopting this Code, UAS industry manufacturers and users commit to the following:

Safety

- We will not operate UAS in a manner that presents undue risk to persons or property on the surface or in the air.
- We will ensure UAS will be piloted by individuals who are properly trained and competent to operate the vehicle or its systems.
- We will ensure UAS flights will be conducted only after a thorough assessment of risks associated with the activity. This risks assessment will include, but is not limited to:
  - Weather conditions relative to the performance capability of the system

- Identification of normally anticipated failure modes (lost link, power plant failures, loss of control, etc) and consequences of the failures
- Crew fitness for flight operations
- Overlying airspace, compliance with aviation regulations as appropriate to the operation, and off-nominal procedures
- Communication, command, control, and payload frequency spectrum requirements
- Reliability, performance, and airworthiness to established standards

Professionalism

- We will comply with all federal, state, and local laws, ordinances, covenants, and restrictions as they relate to UAS operations.
- We will operate our systems as responsible members of the aviation community.
- We will be responsive to the needs of the public.
- We will cooperate fully with federal, state, and local authorities in response to emergency deployments, mishap investigations, and media relations.
- We will establish contingency plans for all anticipated off-nominal events and share them openly with all appropriate authorities.

Respect

- We will respect the rights of other users of the airspace.
- We will respect the privacy of individuals.
- We will respect the concerns of the public as they relate to unmanned aircraft operations.
- We will support improving public awareness and education on the operation of UAS.

As an industry, it is incumbent upon us to hold ourselves and each other to a high professional and ethical standard. As with any revolutionary technology, there will be mishaps and abuses; however, in order to operate safely and gain public acceptance and trust, we should all act in accordance with these guiding themes and do so in an open and transparent manner. We hope the entire UAS industry will join AUVSI in adopting this industry Code of Conduct.

AUVSI
ASSOCIATION FOR UNMANNED VEHICLE SYSTEMS INTERNATIONAL

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Unmanned aircraft systems (UAS) help accomplish dangerous or difficult tasks safely and efficiently. Whether it is helping first responders, advancing scientific research, or making business more efficient, UAS are capable of saving time, saving money and most importantly, saving lives. But unlike the UAS we typically see in media reports, the types of UAS that will be used domestically will weigh less than 25 lbs, with many weighing less than 5 lbs. with an endurance of 30-90 minutes in the air.

Legislation passed last year requires the FAA to safely integrate UAS into the U.S. national airspace system (NAS) by 2015. Public safety agencies may only fly UAS if they have received a "Certificate of Authorization," or COA, from the FAA and COAs clearly outline when, how and where these small UAS may fly. They must be flown within line of sight of the operator, below 400 feet and only during the daytime. Below are a few examples of small UAS used by public safety agencies:

Photo: USGS

The Raven
Weight: 4.2 pounds
Length: 3.0 feet
Endurance: 60-90 minutes*
Range: 10 kilometers*

The Qube
Weight: 5.5 pounds
Length: 3 feet
Endurance: 40 minutes*
Range: 1 kilometer*

Photo: AeroVironment

Photo: Mesa County Sherriff Department

The Draganflyer
Weight: 2.2 pounds
Length: 34.25 inches
Endurance: 90 minutes*
Range: 500 meters*

*Endurance and range will vary based on weather conditions, the size and weight of the camera and more.

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